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COLD STORAGE AND PUBLIC HEALTH[1].

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Instead of reading a formal paper, because formal papers are better read than listened to, I want to make an address and to introduce this interesting symposium,—since I have that honor and privilege,—with a few very fundamental considerations.

One is tempted to go into the historical side of the matter and show how, in his own boyhood, when there was no such thing as formal cold storage, meat and milk were hung down in the well, and how, often-times, when spring came, there were very few or no vegetables other than potatoes and cabbages available for the ordinary household. But that is not the subject of my paper. Mine is the more difficult matter of trying to correlate cold storage with public health, and I shall try to stick closely to my text. The reference that I have made, however, shows that before we had cold storage, there was great difficulty in providing suitable food and in keeping that food, especially in temperate climates, which have seasonal changes. Now, at that time, the temptation to keep food too long was very great and the necessity of going without much of the good food that we get today was imperative, so that in the past, without cold storage, the public health was endangered by the temptation to use food that had not been properly kept, and by the lack of sufficient variety at certain seasons. There was also the danger of over-eating of salted foods and we all know how much of the history of scurvy comes along that line. Scurvy was cured in the first instance, you remember, by lime-juice, not by cold storage, but who hears

[1] Stenographic report.

of lime-juice today except in the British Navy, where the men are still familiarly called lime-juicers by the people in other navies and by merchant seamen. Now, under conditions like these came cold storage, and the result is that we may have today at any season, anywhere, fresh food, that is to say, not salted food, and in the greatest possible variety. It is, however, frequently alleged by easy talkers on this subject and by the newspapers that follow on their heels, that a great deal of sickness comes from cold storage food. But remarks of that kind though easy to make, are very difficult to prove. Mr. A. eats a meal containing some cold storage material and he feels bad afterwards. He naturally lays this to the cold storage food. But, ladies and gentlemen, *post hoc* reasoning has always been the bane of the medical profession and I sincerely trust it will never be allowed to become the reproach of the sanitary profession. We want proofs, we want facts, and not suppositions or mere *post hoc* reasoning. I have taken pains to run down a number of alleged cases of poisoning by cold storage food, and not one of them has proved to be of any consequence, such as would enable it to stand in a court of law. I have no doubt that some cold storage food is bad. I have no doubt that some food that has not been in cold storage is bad. I have no doubt that some food is put into cold storage which was bad when it was put in and bad when it came out, possibly a little worse when it came out than it was when it went in, but not much, and so I am very skeptical on this matter of injury to the public health by cold storage. On the contrary, I believe that one of the greatest blessings that ever befell the human race was the discovery of the principle and practice of cold storage. I would even go so far as to say that we could not, today, maintain in any comfort, the great cities that dot the globe, if it were not for this wonderful system of cold storage; and so, as I say, I have yet to discover any appreciable ill effects from cold storage upon the public health, while I can discover any number of blessings to the public health from an abundant dietary, from cheaper food than would otherwise be practicable, and from the substitution of fresh material for material which was spoilt or which was salted.

Now, it is commonly allowed that much of what I am saying is certainly true, but that there are many abuses in connection with cold storage: first, sanitary abuses, which affect the public health, and second, financial abuses, which affect the public purse and indirectly, therefore, the public health. Of course, if bad food is put into cold storage, as I have already said, the cold storage won't improve it any and will probably allow it to deteriorate slowly, meantime; and I believe that instead of taking so much pains about what comes out of cold storage, the proper place for health men to operate is on the placing of things in cold storage. If we could keep out of the cold storage warehouses that food which is just on the edge of spoiling and is put in there only to save it for a little time, we should make a great gain.

We might not save many lives, but at any rate, we should improve the quality of the food output from those warehouses, and I feel strongly that we ought to give more attention than we now do to that end of the subject.

When it comes to the matter of labeling, when it comes to the matter of the length of time in storage, these are technical points that I have no doubt other speakers will touch upon. I have strong feelings and convictions upon them myself, but it is unnecessary to go into them at any length here. I do believe, however, that the time element is comparatively unimportant and that all the attempts, largely political, which have been made to limit the time of storage to three months or six months or nine months, are futile and of little consequence for the public health,—of no consequence to the public health. They may be of some consequence to the public purse, but nature or the season limits these things and the proper basis should be seasonal periodicity. A year is the natural and should be the legal limit in climates like ours, because then the next crop comes into competition with the old crop, and if any limit is needed,—which I do not believe,—then it would be natural and proper to have it the limit nature has set to production. I do not believe that any limit is necessary and my reason is this, that the accumulation of the charges for storage, interest, taxes and all those things, will, in 999 cases out of 1,000, oblige the packer of foods in cold storage to get rid of them, even at a great loss, before the next season's crop comes in. Gambling in food stuffs has always been one of the most dangerous things in the world for the gambler, and gambling in cold storage, in my judgment, is no exception. However, I am wandering away from my subject, which is the influence of cold storage on the public health. I believe,—to sum it all up, and I need not make a long talk, for the subject is very simple,—that, by cold storage today, rightly supervised by boards of health, as it should be, the public health has been and will be immensely promoted. I believe that the public health will also be promoted indirectly through the cheapening of costs. Secretary Wilson, in one of his publications not long ago, said that cold storage was undoubtedly a great benefit to the human race, but it was a question whether it did not increase the cost of food. The facts are, as studied by economists, that in all probability cold storage cheapens the cost of food and in two ways: first, by saving what would have been lost at one season and keeping it over to another, when prices would have been much dearer than if it had not been kept and the supply at the later period increased, and secondly, by encouraging production. Take a farmer in the West, who is producing anything for cold storage or anything which is eligible for cold storage. Suppose there were no cold storage, he must sell forthwith for what he can get. The cold storage warehouses have enlarged his market, and have thus encouraged his production. Do away with cold storage or interfere too much with the time limits, and you cut off the demand, and if

you cut off the demand once for even one season, you diminish the supply in the next. If cotton is high this year, the farmers plant more cotton next year. If cotton is low this year, they plant less cotton next year. If fewer things to go into cold storage are demanded this year or if there is no cold storage, the farmers will go out of the raising of those particular things and the supply will be diminished, and it is the supply, in the long run, which regulates prices. Now, if prices get high, the public health suffers, and I, for one, in these days of so much talk about the high cost of living with so much truth in it, am very eager that we, as sanitarians, shall not too much increase prices by unwise or needless propositions in regard to foods and drink for man. It is very easy, by making sanitary requirements too difficult, by hampering the farmer in a thousand ways, it is very easy, I say, to discourage him and lead him to go into some other line of production that diminishes supply and makes prices jump up. When prices rise, the poor get poorer food; and when the poor get poorer food, the public health suffers. And so, Mr. Chairman, without stopping to repeat or strengthen any of these remarks, I may simply recapitulate by affirming, in the first place, that there is, so far as I know, no good evidence that cold storage products are injurious to the public health. Of course, there have been cases, very many cases, of alleged injury, but these injuries were not due, necessarily, to cold storage. They may have been due to the poor quality of the food at the outset,—and cold storage cannot redeem bad food. In the second place, those cases are very few and far between, anyhow. I saw, for example, this winter a statement that a man in a neighboring city to mine had died from eating a cold storage egg. I ran the thing down and found that the man had not died from the egg at all; he had apparently died from pancreatitis, and it was a newspaper exaggeration, pure and simple. I believe, on the contrary, that cold storage has improved the public health and it is capable of still further improving it, immensely improving it. I believe, however, that, like everything of a big sort nowadays, it needs regulation and that the public has a right to know what it is getting and under what conditions. The "rule of reason" applies here as everywhere,—reasonable time limits, reasonable labeling, and especially the safeguarding of food that goes into storage, to see that none but good food goes in; these appear to me to be the main points for proper protection of the public health.

PHYSICS OF REFRIGERATION.

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Feeling in some measure responsible for bringing the importance of refrigeration as an economic, social and health necessity before the Association last year, I propose to allow those who have been especially engaged in illustrating its practical application to occupy most of the time allowed for the symposium.

The rapid and general adoption of refrigeration will have been accomplished whenever we shall have convinced the producer that he can conserve his products to financial advantage, and the consumer, when he realizes that through cold, nature has supplied a means of arresting almost indefinitely the tissue changes which take place in animals and plants in the natural processes of decay common to all organic matter when once deprived of life. Thus Edelmann in his recent work on meat hygiene says "Putrefaction of meat is a bacterial decomposition, which by adequate treatment, curing or preserving may be checked. On the other hand it is above all superinduced by heat and moisture. The last two factors facilitate the growth of putrefaction organisms." There are evidently three principal factors entering into the preservation, unchanged, of the tissues of all products, whether of plant or animal, viz:—

(*a*) Securing the mature, healthy and sound product as free as possible, whether on the surface or in the deep tissues, from microbes of fermentation and putrefaction.

(*b*) The surrounding of the fresh products with pure air which contains always the normal proportion of oxygen, and of a relative humidity at from 65% to 75%.

(*c*) The maintenance of the lowest degree of cold found necessary to best preserve any particular product.

While to the popular mind which only knows of the kitchen refrigerator, the problem seems a simple one, yet daily experience shows, whether at the farm or in slaughter-house, or in the store or butcher shop and later on in the railway car or on shipboard, so many examples of but very partial success or even absolute failure in preserving foods, that the experienced cold storage operator who has made refrigeration an art, knows that here as in all other business, the application of the principles of pure science results in first-class products, and good business returns the same, as when applied in any other industrial concern.

Hence, for a few moments, we may concern ourselves with some of the physical principles involved in the three chief factors already mentioned of the refrigerating process.

Dealing with the first point, that of the quality of the product, to be placed under refrigeration, G. H. Powell, lately of the Bureau of Plant Industries, Washington, has said that 90 per cent. of the success in fruit cold storage depends upon (*a*), the careful picking and packing of mature fruit, which primarily depends upon the proper scraping and spraying of well-pruned trees, grown on rich, well-tilled and well-trained soil.

(*b*) It next depends upon the rapid reduction of the temperature of the picked fruit or killed meat, to a temperature at which the microbes do not readily grow. This means in all cases open handling, that is, fruit in boxes, so that air will readily circulate through the fruit and of carcases hanging separately so that air may reach each part.

The second point, that of surrounding the products with pure normal air of proper relative humidity, of course involves the application of mechanical methods. It will be apparent that while the refrigerating machine, such as the ammonia compressor, performs its work of producing cold by abstracting heat through the evaporating of liquid in pipes, the work of carrying the cold to the cold stores involves the principles of ventilation as applied to the circulation of warm air or the abstraction of foul air. It likewise involves the first essential to good refrigeration, namely, a well-insulated building as little affected as possible by outside heat or cold. In German abattoirs it is laid down as a principle that the air surrounding the carcases, held in cold storage must be changed at least four times in twenty-four hours, which according to the higher outer temperature may demand an amount of refrigeration in warm weather greater even than that required to supply losses through defective wall insulation in the cold storage room itself.

Even though the temperature in the cold storage be so low as to prevent microbic growth, yet experience teaches that volatile organic emanations, whether from meat or fruit, which are highly complex compounds do abstract oxygen from the confined air and do encourage surface fungoid growths and anaërobic action; but the introduction of fresh outer air immediately involves the danger of a saturated air being produced whenever an outer atmosphere of say 80° F. is reduced to say 10° F. in temperature. Fortunately, the solution of the difficulty is easy since the fresh air is drawn by the circulating fan over pipes filled with brine below 32° F. and hence deposits its moisture as frozen vapor on the surface of the pipes. Thence passing on to the cold storage it gradually increases in temperature and so has lessened its relative humidity. But inasmuch as fruits, if in a too dry air, lose moisture and become shrivelled, it is equally essential that an adequate humidity of 70% to 75% be maintained. Manifestly, there-

fore, in view of the variation in building construction, in the quality of the insulation, in the position of the building as exposed to winds and variations in outer temperature, and equally owing to the varying effectiveness of machinery and the attention given to its operation by the engineer in charge, the maintenance of a proper relative humidity within a small range of internal temperature is a matter of extreme importance, demanding good mechanism and intelligent oversight.

On shipboard and in refrigeration cars thermographs are installed in the cold storage to register the variations in temperature which will indicate also closely the relative humidity; while automatic indicators in the engine-room attached to the thermostats in the various cold storage compartments of buildings, or ships announce to the engineer sitting at his desk variations in temperature not exceeding a degree, and so enable him to lay on more or less cold as the occasion demands. Indeed anyone traveling on ocean liners finds fresh fruit brought to the table at times in a stiff or even frozen condition, which requires a short exposure to a higher temperature in order to place it in the proper condition for eating. It would seem that even citrus fruits are with profit being lowered in their storage temperature from the 40° F., which is set as a standard for transcontinental car transportation.

It is hardly necessary to point out that at temperatures approximating freezing, the relative humidity, if more readily approximating saturation with a slight fall of temperature, does not have the same importance in the matter of favoring fungoid growth as at temperatures above 35°. Extended fruit experiments have shown, however, that the brown fungus spot in the interior of apples may grow at temperatures above 35° without any surface appearances of change in the apple, and would seem to be especially present in certain fruits grown in soils over-irrigated, but are still more influenced by a too humid cold storage atmosphere.

The use of low temperatures in ice cream manufacture and the varying temperatures from 10° to 20° F. for cream mixtures with different flavoring extracts is one of the most interesting and remarkable illustrations of the use of cold in the manufacture and production of foods, and is one quite worthy of a paper devoted to it alone.

I have briefly indicated the requirements of cold storage in their application to the preservation of meats, fruits, etc., and now desire to say a few words about its wider application. Judging from my past experience with persons even well informed in science generally, there exists a very widespread ignorance, not alone of what refrigeration is expected to do, but even more of how it is mechanically produced. In a general way we speak of heat, but do not really realize its physical meaning. We do not think of earth, fruits or carcases holding in their constituent particles a something which by vital action or chemical rays has taken a definite period of time

to be stored up, and which will demand an equal amount of transference to a colder body in what we call heat loss, if definite lower temperatures are to be reached. As heat is a form of energy implying molecular movements in the particles of any substance, greater with increasing temperature, so to prevent such active molecular movements we must lower the temperature by the transference of heat through conduction or radiation to some other substance. It is essential that we realize how this is brought about in the ice machine by some gas, for instance, ammonia. The principle of the loss of heat may be thus expressed:—

d. = fall of temperature.
p. = pressure before expansion of gas.
P. = pressure after expansion.
t. = the temperature in degrees at which a compressed gas expands, the pressure being expressed in atmospheres.

The idea is most readily obtained by picturing a receiver or iron drum holding anhydrous liquid, ammonia usually, at a temperature of 90° F., and a pressure of 150 pounds per square inch. Attached to this by iron pipes is a pump operated by belting or electric motor which by exhausting the ammonia in gaseous form lowers the temperature of the air or liquid brine surrounding the pipes. Passing the piston the gases are compressed, thus again having heat produced. Through the cold water of a condenser the gas is passed and so again cooled on its way to the original iron drum, so completing the circuit. The cold thus produced is applied to the surrounding air of the cold storage, either directly through the exhaust pipes placed in the cold chamber, by circulation of air around these pipes placed in a separate room and driven through the cold storage by a fan, or what is still more common by a 15 per cent. calcium chloride brine being cooled in a tank by the ammonia pipes and then circulated through the cold storage rooms by being pumped through iron radiators laid about the ceiling and walls.

It is hardly necessary to say that successful refrigeration involves that goods shall be taken from this cold storage in the pink of condition; hence, this demands that perfectly fresh, matured products shall at the beginning be placed in the cold storage and when so placed given the most skilful treatment possible during their detention there. Being essentially an economic proposition, it means the most careful attention by the engineer in charge of the temperature and relative humidity of the cold storage room, assuring that such be neither too high nor too low. The more delicate the thermometer, the greater the success in maintaining evenness of temperature. Necessarily the item of cost of operation is of prime importance, and hence the engineer must estimate daily the amount of work done by his engine and machine in the degrees of cold or amount of ice produced

compared with the fuel consumed or power supplied. The item of a water for condensing purposes, low in temperature and abundant in quantity, is very important in determining daily profit or loss. It is evident that the degree of the temperature of the ammonia in the receiver will determine the difference of temperature between the expansion and compression sides of the pumps, and hence the ratio of efficiency.

But it is only necessary to say in concluding these fragmentary remarks that while the perfection of any product placed in cold storage is a *sine qua non* to highest success, whether hygienic or commercial, yet permanent results must depend upon how economically and yet efficiently the mechanical and physical appliances involved perform their work.

THE BACTERIOLOGY OF FERMENTATION AND PUTREFACTION IN RELATION TO THE CONSERVATION OF FOODS.

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Conservation of foods is in general accomplished by either the destruction or the inhibition of the bacteria which are certain to gain access to them. A consideration of the bacteriology of fermentation and putrefaction in relation to the preservation of foods would, if complete, contain the results of a large number of researches, and a very extensive list of so-called species of bacteria which investigators have described as important in connection with this subject. Since this is manifestly impossible in a short paper, it has seemed to me best to describe at the outset the types of substances available as food and to point out the character of the chemical change which each of these kinds of materials undergoes. In this way we may deal with the microörganisms as groups rather than as species, and the subject becomes less detailed and more easily considered.

Our staple articles of food are of particular value because of the occurrence in them of proteins, carbohydrates or fats which can be transformed by the enzymes of the alimentary tract into energy or matter directly available for the running and repair of the living mechanism. Of these, the proteins are the chief muscle-forming foods, while the other two are more quickly oxidized in the body and the energy is largely transformed into heat rather than modified into the tissue substance. Although we speak of each of these types of foods as an entity, in but few cases do we have any one of them entirely free from one or both of the others, a point which is of some importance in the consideration of questions pertaining to conservation. While especially thought of as food substance for higher animals, all these foods are subject to microbic action, that is, serve as food for the different kinds of germ life. The proteins and carbohydrates are of special importance from the standpoint of food preservation because they are relatively easily attacked or destroyed by microörganisms of different kinds, and especially by the bacteria, with the formation of cleavage products poorer or lacking in food value, depending upon the rate and amount of decomposition, and resulting finally in the total destruction or spoiling of the food. The fats, on the other hand, show considerable stability, at

least toward bacterial activity, although they too may undergo decomposition by microörganisms to such an extent as to make them objectionable as food.

All the changes induced in food substances through the activity of bacteria or nearly related organisms may be grouped together under the general name of "fermentation." The term, as thus employed, is a general one, and embraces a large number of specific chemical changes induced by the organisms of different types. The products of these fermentations are very numerous and may be of widely different character. The foods in which carbohydrates predominate are in general acted upon by certain classes of bacteria or by yeasts and moulds with the formation of acids or alcohols as the final products of the fermentation. Along with the acid formation there may also take place the evolution of gases, particularly of carbon dioxide and hydrogen.

The protein-containing foods, on the other hand, are subject to fermentative processes of a widely different type and these processes themselves may be further placed in two groups according as the organisms involved are aërobic or anaërobic in character. Those decompositions of nitrogenous material in which products extremely objectionable in character and of vile odor are frequently formed are generally grouped under the name of "putrefaction" or "putrefactive fermentation." In some instances, particularly with aërobic bacteria, oxidation processes are carried out in which these offensive substances are formed in but small amounts and to these frequently the term "decay" is given, while the stronger term "putrefaction" is reserved for the anaërobic fermentations in which the malodorous products are most conspicuous and the oxidations much less complete. Certain classes of foods, as for example, the edible seeds of plants, which contain both carbohydrates and protein in considerable amount, are subject to both these types of change, the predominant one depending upon the character of the infection and upon the conditions of temperature and air supply. The substances rich in nitrogen and sulphur, that is, the proteins, through the agency of putrefactive bacteria give rise to basic or alkaline end-products, while the foods essentially carbohydrate in character give rise to acids. In both cases the changes go stepwise through a number of intermediate stages, these intermediate products consecutively diminishing in complexity so that, in general, the final cleavage products are mixtures of such simple substances as ammonia, carbon dioxide, sulphuretted hydrogen and mercaptans with amines and still more complex products of putrefaction. Organic acids, of weak types, may also be produced in small amounts and frequently these are at once neutralized by the basic or alkaline products which are likewise formed.

With the carbohydrates, the trend of the reaction is essentially that of hydrolysis, the splitting of sugars or starchy substances into simpler sugars,

and the fermentation of these, with or without gas formation, to different acids, particularly lactic, butyric, formic and acetic acids. It may be further noted that proteins of different sources, or different proteins give essentially the same substances on decomposition.

Turning now to the organisms involved in these changes, we find that they may be grouped in a few groups more or less merging into each other and occurring around a few type species. Researches on putrefaction have been carried out for many years. Early investigations were made with mixed cultures of unknown species and their value lies chiefly in indicating the extent to which the decomposition processes may go on rather than for any information obtained as to the character of the inciting organisms themselves. The so-called Bacterium termo, a name which was early given to minute organisms found in decomposing matter, is now known to be of absolutely no value from the taxonomic standpoint. The organisms grouped under this general name were merely of minute size and occurred in putrefying materials, and undoubtedly consisted of many varieties or types of bacteria of small size which happened to occur together.

It was not until the work of Hauser, working with pure cultures, that the bacteriology of protein decomposition began to be elucidated. He discovered, or rather isolated, several kinds of organisms to which he gave the name Proteus, and among these, Proteus vulgaris, or as it is known today, Bacillus vulgaris, was apparently of the greatest importance. This organism is characterized by vigorous motility and marked proteolytic power; and occurs widely in decomposing organic matter. It has no spore formation but seems to possess great chemical activity, affecting a wide variety of substances, not only proteins, but also to some extent sugars, upon which it produces organic acids as well as carbon dioxide and hydrogen. Around this organism as a type form are grouped many others which are similar to it in character, except that they may vary in sugar fermenting power or in the ability to elaborate the same number of enzymes. In most of these, however, the secretion of invertase, rennet, lipase and trypsin takes place. A step further removed, but still nearly related, is a large group of organisms characterized by the power of rapid liquefaction of gelatin and by the formation of green fluorescent products. Best known among these are the organisms Bacillus fluorescens and Bacillus pyocyaneus of which many races or sub-types occur. Furthermore, these are more or less modifiable as to liquefying power and color production, depending upon the character of the food and the temperature at which they develop.

A step farther away are certain organisms of marked chromogenic power, such as Bacillus prodigiosus which, under certain conditions, gives rise to distinct putrefactive changes. The organisms of the hay bacillus type must also be grouped among those which are potentially proteolytic in character and capable of inducing putrefactive change. The organisms of

the colon group may also be considered from the standpoint of their power to cause putrefaction. This great group which exceeds all others in the actual number of bacteria in the intestinal tract of warm-blooded animals presents to a more marked degree than the preceding groups the dual personality of being putrefactive and fermentative at the same time. Grown upon media free from carbohydrate and containing albumose or peptone, putrefactive change takes place. On the other hand, if certain carbohydrate foods are present and the temperature is a satisfactory one the fermentative or acid-forming function of the organisms become predominant, acids are produced in liberal amounts, and putrefactive change is checked. We may say, then, that the general result of the development of the colon bacillus and its nearly related species within the alimentary tract is to check intestinal putrefaction and to operate in opposition to the pronouncedly putrefactive types, while on food substances poor or lacking in sugars outside the body, its action is very likely to be putrefactive and destructive especially to secondary protein. Among the cocci, also, various kinds possess the power of inducing both putrefactive and fermentative change, so that a rather ill-defined group of this family, characterized perhaps by its acid-forming power on the one hand and its pathogenic power on the other, must be classed with the putrefactive organisms.

Most important of all the bacteria, from the standpoint of true putrefaction, is the group of anaërobic organisms of which the Bacillus putrificus of Bienstock is the type. To the organisms of this group may be ascribed the most rapid and thorough disintegration of proteins, hence, they may be called the true putrefiers. This organism (B. putrificus), which is anaërobic in character and produces drumstick-shaped spores is, according to Klein, the most important organism concerned in the decomposition of dead animal bodies. It is certainly one of the most vigorous organisms engaged in putrefactive change. Under anaërobic conditions it produces strong tryptic digestion or fermentation, and gives rise to amines as end products of the reaction. Closely related to this are three other strongly anaërobic types, Bacillus perfringens, Bacillus bifermentans sporogenes and Bacillus gracilis putidus. Of these three markedly anaërobic putrefactive types of organisms the last does not ferment sugar while the others prefer the presence of sugars and are able to break them down more or less completely. Undoubtedly here, as in most instances, the presence of large amounts of sugar would have a decidedly restraining action upon the putrefactive functions.

As with the aërobes, collected about these type forms are numerous intermediate or variant species, so that in any organic material undergoing a spontaneous, that is, "natural" putrefaction, the observer might find a

great variety of organisms but few of which correspond absolutely to the type species which have been named.

The above mentioned groups of bacteria may be arranged in two great classes. First, the *true* putrefactive bacteria or *those which decompose native protein*. These include (*a*) all strong anaërobic bacilli; (*b*) Bacillus vulgaris; the organisms of the Bacillus fluorescens type; Micrococcus pyogenes; many spore-forming rods, among them soil bacteria especially belonging to the groups of Bacillus mesentericus, Bacillus subtilis, and Bacillus ramosus.

Second, those which decompose protein *clearage products*, but because of lack of tryptic enzymes cannot break down native protein itself. These affect especially albumoses and peptone, hence are of less importance from conservation standpoint than the first group. Under this heading appear many organisms both of bacillus and coccus forms, some of which are strongly fermentative in character, as, for example, some organisms of the colon and lactic groups, B. prodigiosus, Micrococcus, etc. With a single exception these are all aërobic or facultative forms. In this group we find the connecting links between the characteristically putrefactive and the characteristically fermentative types.

Turning now to the fermentation of foods of plant origin, and especially those rich in starch and sugar, we find a large number of so-called species which may be more or less active. Since the general tendency in this type of fermentation is to produce acids, only those species which can endure considerable acidities will long persist, the others gradually being eliminated as the growth conditions become unfavorable. Here, too, should be mentioned more emphatically the action of sugars in restraining putrefactive change, a phenomenon which has the effect of still further checking the development of the true putrefactive organisms of the first group. Notwithstanding this, the organisms involved in the fermentation of carbohydrates are in certain instances of the same species as those found among the putrefactive groups. This is particularly the case with the second group mentioned above. Bacillus coli and Bacillus aërogenes and their various relatives, the enormously large group of the lactic acid organisms, both aërobic and anaërobic, and many cocci belong to this class. Of the greatest importance here, however, are the lactic acid producing organisms. As regards oxygen, many of these are facultative in character, and they are also capable of growing at either high or moderately low temperatures (ranging from above 50°C. to 0°C.), and give rise to lactic acid alone or to mixtures of lactic, acetic, formic and other acids either with or without gas formation. The character of the substratum determines to some extent the amount of decomposition which may thus take place. By their acidity, substances rich in sugars and starches undergo marked acid fermentation with suitable physical conditions, concentration, temperature, etc., and

become not only disagreeable and sour to the taste, but may frequently contain quite high percentages of lactic acid. The rapidity of their action is sometimes startling, a few hours at a favorable temperature sufficing to permit extraordinary chemical changes.

Two distinct types of lactic acid organisms may be recognized, each of which may be markedly destructive to foods; first, those in which the sugar is split directly into lactic acid with no gas formation, as, for example, the true Bacillus acidi lactici group. Second, those in which gaseous products are found as well as the acids, as in the colon and lactis aërogenes group. In this class of carbohydrate fermenting organisms must also be included the butyric acid group which ferments starches and sugars into butyric and acetic acids with the formation of various gaseous products at the same time. This group works for most part anaërobically and consists of a number of different organisms varying slightly in general character but for the most part spore-forming, and capable of developing only within rather limited temperature conditions. Here also should be considered the organisms causative of the rotting of vegetables, mostly of the pseudomonas group. The yeasts and moulds capable of producing alcoholic and allied fermentation also belong in this division.

It has been impossible in the scope of this paper to describe in detail all the organisms which are known to play an important part in food decomposition. The above brief characterization may suffice, however, to show how numerous they are and how manifold is the action which they may induce. Of fundamental importance, when considered from the standpoint of food preservation, is the fact that in spite of their great individual differences in behavior and chemical activity, they all respond to the general law which is observed with all living things in relation to extreme heat and extreme cold. Whether spore-forming or not, short periods of heating at temperatures of 120° C. suffice to destroy all the cells, and continued exposure at temperatures of 0° C. or below suffices to inhibit almost completely all these organisms. This inhibition is, of course, but temporary in many instances, enduring merely as long as the organisms are exposed to the low temperature. When the food substance infected with these organisms is again brought to ordinary temperatures the organisms again spring into activity and begin their destructive chemical work.

THE HYGIENIC AND ECONOMIC RESULTS OF REFRIGERATION IN THE CONSERVATION OF POULTRY AND EGGS.

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Read before the American Public Health Association, September, 1912, Washington, D. C.

Refrigeration, to the laity, is generally synonymous with what is termed "cold storage"; that is, the preservation of perishable products by means of low temperatures continued for thirty days or more. It is on the subject of the application of refrigeration in the form of cold storage that the press of the country has gone quite mad, and concerning which there have been reams of evidence presented to legislators, boards of health, chambers of commerce and investigating committees of one sort and another. From the attention which is being paid to this phase of the application of refrigeration one might infer that if not the only question of importance it is, by far, the most important,—an assumption which, according to the facts, is distinctly erroneous. The most weighty rôle which refrigeration has to play in our economic scheme of things is to assist us in getting perishable products from the producer to the consumer in good order, and for most of these products refrigeration is an essential at every step of the journey.

To illustrate these statements specifically, let us consider the handling of poultry and eggs under modern conditions of scattered and distant production and concentrated consumption. The source of supply of poultry and eggs for the East is steadily moving westward. Forty years ago, New York City received its poultry from its own state and New Jersey; twenty years ago it seldom needed to go beyond Ohio to satisfy its demands. Now it draws the bulk of its supply from the Mississippi and Missouri valleys, and when some unusual scarcity arises it goes even farther afield. For instance, during the severe winter of 1911–12 it sent to California for its *fresh* eggs!

Another potent factor to be considered is that the people in the cities now demand poultry and eggs throughout the year, whereas they used to be almost exclusively seasonal articles. Eggs came in the spring, chickens in the autumn, and turkeys in the winter. The produce men could not get eggs in the wintertime for love nor money, and in the summer they

could not prevent their poultry from spoiling—hence, it was either carried alive or not carried at all.

Now the farmer, who used to drive to market with his fresh vegetables, butter, eggs and chickens, is being pushed farther and farther from the cities by the growth of their outlying districts, and he must get his produce to market in some other way. Accordingly, he developed the plan of dressing his poultry on the farm, chilling it with water, packing it in barrels with crushed ice, and sending it by rail to market. Very seldom did he make a specialty of this business. It was just one of the many farm side issues which he might, perchance, do well, but was far more apt to do badly. Then came the reign of poorly handled, half-decomposed poultry and stale, low grade eggs—a condition for which there seemed to be no remedy until mechanical refrigeration became available and the problem of existing conditions, of source of supply and consumptive demand was attacked with breadth of view, scientific accuracy and patience, and the coöperation of the progressive men of the industry to put into practice on a commercial scale the improvements which experimentation suggested.

Such a study of the subject indicates that it is a most complex problem, involving physical, chemical and bacteriological principles. When it began science had but little in the way of pre-gathered, definite results to give us. The best came from the engineers. Our knowledge of the composition of fresh chicken flesh, its permissible variations, its divergence from the normal under varying environments and what conditions were conducive to its stability were all unknown. To study only certain parts of the market history was worse than useless because, taken without due cognizance of the whole, such would be misleading. Therefore, in order to build safely and sanely one must go back to the place and time of slaughter and follow every detail in the packing house, during the railroad haul, in the house of the commission man and the shop of the retailer.

That the methods for the handling of dressed poultry based on mechanical refrigeration and the old procedure where crushed ice was the foundation may be comprehended, let me describe briefly the routine pursued in each case.

The "ice packed" birds killed by some one of the prevailing methods and defeathered by what is termed "dry picking" or "scalding," are thrown into cold water in large tanks or hogsheads. Sometimes running water is used, but generally the tanks are filled when work begins in the morning and it is a very unusual dresser who empties and refills his cooling water more than twice daily. Several hundred chickens, therefore, with dirty feet and bloody heads, are soaked for from one to nine or ten hours in the same water, which becomes very filthy.

Having reduced the animal heat of the chickens to the temperature of the water, some large pieces of ice are thrown into the tank and replenished

from time to time until the kill is to be packed, which may be anywhere from twenty-four hours to four or five days. At that time barrels—old or new—good or bad—large or small—have several inches of crushed ice put into them, and on this ice is placed a layer of chickens. Fine ice is packed around and over them and then comes another layer of chickens, and more ice, and so on until the barrel is filled, when a large piece of ice is put on top, sacking or canvas is nailed over the opening and the package leaves for market by freight or express under refrigeration or without it. So much for "ice packing."

When "dry packing" is used the killed, picked fowl is transferred within a few minutes to an insulated mechanically cooled room where the temperature is maintained at 32° F. or a few degrees higher. In about twenty-four hours the temperature of the flesh of the chicken has fallen to that of the room. The feet of the birds are cleaned before they go to the chill-room, and the heads are wiped and wrapped with a firm, non-absorbent paper; hence, when the animal heat is out they are ready to be packed. The package is generally a small box of tasteless wood, holding twelve birds. Almost invariably these packages are loaded in 10,000- or 20,000-pound lots in refrigerator cars chilled by a mixture of salt and crushed ice.

At no time during their preparation for market does water touch these chickens. Scrupulous cleanliness must be maintained if the product is to preserve its fine appearance on the market. It is not possible to enter here into the details of manipulation by which that cleanliness is attained; but the all-metal cooling truck, whereon the poultry is hung to chill, which is perfectly sanitary and on which the birds do not touch one another, will serve as an example of the type of apparatus that is being devised and installed in poultry packing houses where dry packing has been adopted. When dry packed poultry reaches the market it is kept until sold in the chillroom of the commission man, and generally hung in the ice box of the retailer while in his possession. The ice packed poultry, on the other hand, must be kept in fine ice, or ice water, until disposed of.

In large Eastern cities poultry seldom reaches the consumer until two weeks after killing, and if the market drags it may be almost three weeks. If dry packing is used, and low temperatures carefully maintained, the maximum flavor and tenderness of the flesh is attained in about eight or ten days. If wet packing is used the flavor is never as good, and the keeping of the flesh is so uncertain that nothing definite can be said about the period of ripening.

The gross differences in the appearance of similar chickens handled according to these two methods may readily be seen. The deeper significance of the invasion of the flesh by bacteria and its alteration by long contact with water will be apparent to the bacteriologist and physiological chemist, respectively. Such data have been obtained in the laboratory

studies which have been made in the course of these investigations and are very striking since they coincide with desirability in appearance and quality of flavor, and give definite reasons for the facts which are visible to anyone in any poultry market, provided he be an unprejudiced observer.

Chart 1* represents graphically, as well as numerically, the relative rate of increase in the number of bacteria in dry packed and wet packed poultry, beginning in the packing house twenty-four hours after killing, and continuing through the whole course of marketing—a period of about twenty days. "A" represents dry packed birds; "B" wet packed. The number of bacteria is calculated on the basis of one gram of flesh. The different periods, represented by 0, 1, 2, 3 and 4, correspond with twenty-four hours after killing; the end of a six-day railroad haul to the market; the expiration of a five-day sojourn in the chillroom of the commission house; a four-day period in the ice box of the retailer and an additional three-day period in the same environment to determine what would happen if the market should be badly glutted and sales unduly delayed. The chart is the result of the study of fifty or more shipments from different parts of the country and throughout the entire year. The handling of the birds was excellent.

It is noteworthy that the bacteria in the flesh of the water chilled bird gained a distinct ascendency in the first twenty-four hours, an ascendency which is maintained throughout. It is also noteworthy that, in bacterial content, the wet packed birds are always at least one stage ahead of their dry packed fellows. In other words, their keeping time is just that much shorter.

So far as palatability is concerned the birds from the first wet packed sample were always the best flavored; the dry packed was generally best in the second sample. The last sample of wet packed was seldom a desirable food, and frequently unfit to eat; the dry packed was always edible though it had lost much of its flavor. Invariably, throughout the whole series, the wet packed lacked flavor as compared with the dry packed.

Quite aside from the question of the rate of deterioration in dressed poultry is the economic waste to the community by soaking flesh in water, a waste which is avoided when cold air refrigeration is used. This waste is by no means small when reckoned on the basis of the nation as may be seen by the following statement:

The poultry industry is so enormous that computations on the basis of single chickens are misleading. Therefore, the figures to be submitted are calculated to the usual carlot—that is, 20,000 pounds. On an average chickens consist of about 35 per cent. of lean meat—or 7,000 pounds of edible material in the carload. By the time this reaches the consumer, in

* This chart was first shown at a meeting of the Missouri Car-lot Shippers, in March, 1912.

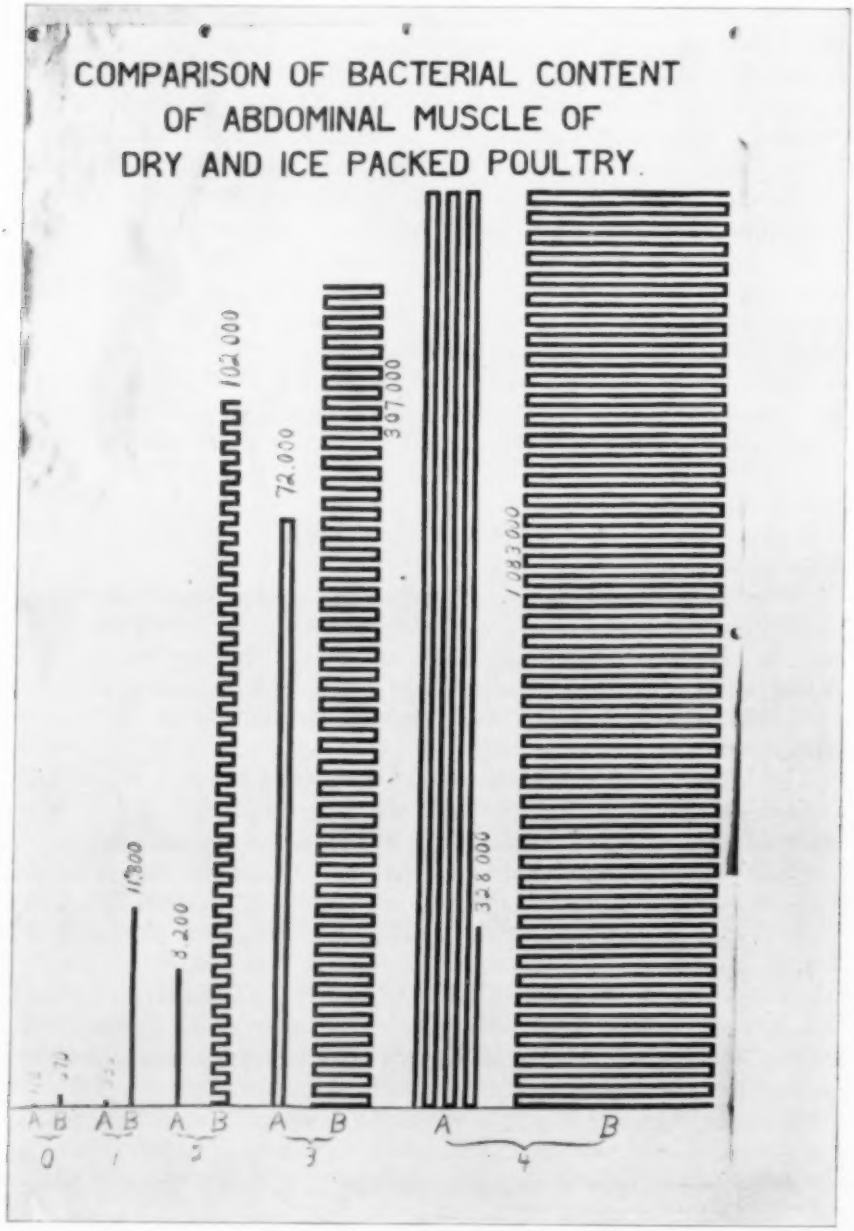
COMPARISON OF BACTERIAL CONTENT
OF ABDOMINAL MUSCLE OF
DRY AND ICE PACKED POULTRY.
17,800
3,200
102,000
72,000
397,000
328,000
1,083,000
A B A B A B A B A B A B
0 1 2 3 4

CHART I.

the routine of marketing, it has lost down the sewers about 300 pounds of soluble proteins and nitrogenous extractives. It has also, during that time, absorbed about 1,300 pounds of water, which the consumer buys at chicken prices. Reckoned in money the loss to the community on every carload is at least 450 dollars—but dollars are, after all, the poorest criterion of a loss which consists in the decreased palatability and food value of so universal a product as poultry.

The time is coming—and coming faster than a cursory observation would indicate—when the dirty, watersoaked, half decayed wet packed chicken will be a thing of the past. Indeed, the dry packed chicken of today, generally handled for prompt marketing between 30°–40° F. will be hard frozen twenty-four hours after killing and so shipped to market and so carried, even to the kitchen of the housewife, who will thaw it in her own refrigerator before preparing it for the table. Some of the more progressive packers are refusing to ship dressed poultry in warm weather unless the customer will take it hard frozen. Very soon the customer dealing with the packer prefers it so, but he is handicapped because the consumer insists that it is "cold storage" and demands "a farmer's chicken that is fresh"— and she gets the thawed companion of the frozen bird, which may have deteriorated in the hands of the retailer and will deteriorate every hour that it is in her possession. As usual, ignorance and prejudice conduce to the disadvantage of all concerned.

As we gain a deeper insight into the effect of small variations of temperature on the rate of flesh decomposition the need for low temperatures in the handling of perishable produce and the quick response which a rise of even a few degrees calls forth in the form of undesirable results, impresses one forcibly. Let me illustrate the point in connection with another and very important phase of the application of refrigeration—namely, transportation in refrigerated carriers.

We have in the United States many insulated carriers which can be refrigerated. Most of our food stuffs which travel long distances are hauled in them, with ice in the bunkers in the summer for cold and stoves there in winter to prevent frosting. Let there be a shortage of refrigerated cars in any section which ships a perishable crop and that crop rots at its source. Let the carriers be badly built or poorly managed in transit and the finest produce ever grown reaches the market in bad order. It is not enough that the product shall be well handled at the source of production only; it must be cared for every step of the way to the consumer. It is not a simple matter to determine what happens to the load when the car is closed at the packing house and not opened again until the market is reached, yet thermograph records, and chemical analyses at the time of loading and immediately after unloading are giving us more and more information; and a specific history of the goods before loading and its behavior

on the market later helps to fix responsibility. The part which temperature, alone, plays in the keeping of dressed chickens is shown by Chart II.

About fifty shipments of dry packed poultry, averaging a six-day haul and covering a period of two years, were grouped according to the temperature which had prevailed in the refrigerated car, and the analyses giving

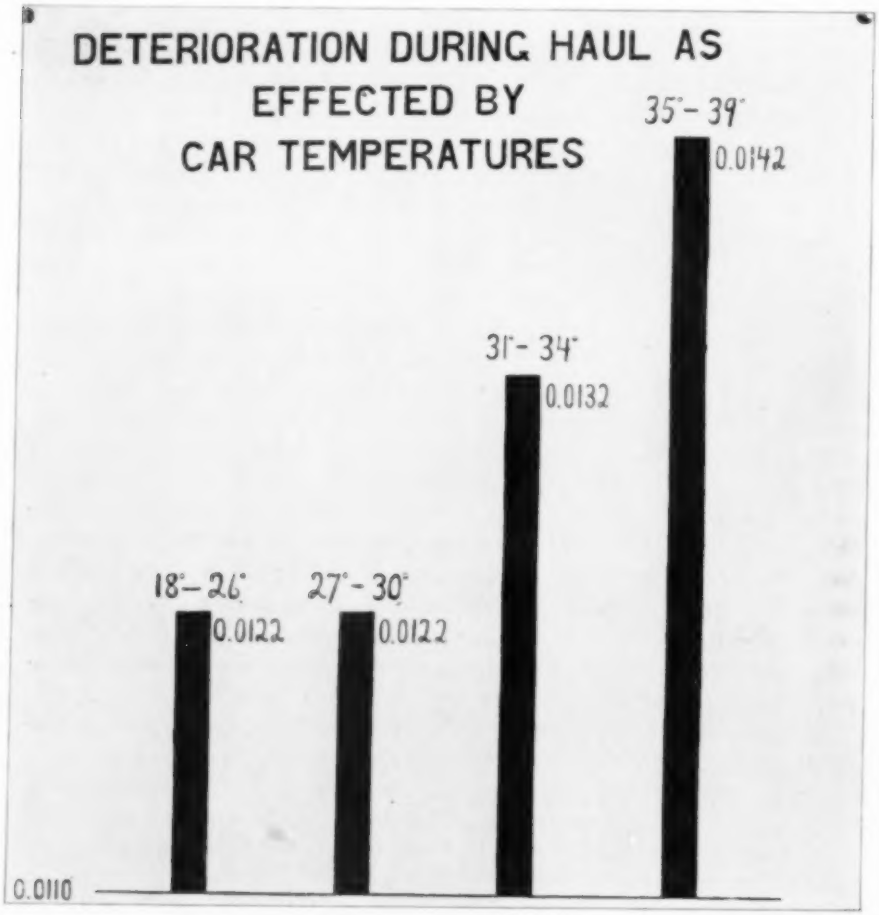

CHART II.

the amount of loosely bound nitrogen averaged for each group. The base line of the chart represents the average composition of a chicken twenty-four hours after killing and from which the animal heat has been promptly removed by cold air. It will be observed that the change in composition is very small when the temperature is below 30° F.—and that there is no

difference, on the average, between 18°–26° F. and 27°–30° F., but both are below freezing. The amount of ammoniacal nitrogen, however, is almost doubled when a rise of 3° takes place; that is, from 31°–34° F.; and again there is a very material increase between 35°–39° F. All these fowls entered the New York market and all of them were liable to be subjected to the same conditions of marketing. Such being the case, a study of that phase showed that the birds arriving in a car where the prevailing temperature was 35°–39° F. were, chemically speaking, just the same age after killing as were the birds hauled at a temperature below 30° F. when they had been on the market for from five to eight days. It is easy to see what such added resistance means to the consumer in gain in condition, and also to the quantity of poultry on the market since there is time to dispose of it before spoilage.

The application of refrigeration to eggs is, from an economic viewpoint, even more important than is its application to dressed poultry, because the egg industry of our country is worth approximately $500,000,000, whereas the poultry industry is worth only $250,000,000; and because eggs have become an almost universal food in homes of rich and poor alike. About ten per cent. of the eggs produced are lost by bad handling before they reach the consumer. A much greater proportion deteriorate in quality and, consequently, in money as well as food value. The destruction begins on the farm with the carelessness of the farmer. It is accentuated in the hot storeroom and by the long holding of the country merchant, and continues while the eggs travel in box cars to the shippers—a few cases at a time—and even beyond him to the city, unless he is provided with mechanical refrigeration and ships under refrigeration. The early spring eggs that reach him before warm weather are almost universally fresh. By applying refrigeration continuously and promptly he can slow deterioration to such an extent that the egg is still edible at the end of nine months.

The eggs which are taken to the shipper during the summer are, almost without exception, lowered in quality by the prevailing temperatures. Even if he has mechanical refrigeration, deterioration having begun cannot be checked as efficiently as it can be prevented. Yet the gain in food quality and the prevention of waste when refrigeration is applied by the shipper to "hot weather" eggs means a greatly increased and bettered egg supply.

Eggs are shipped in a package if uniform size the country over—namely, a case containing thirty dozen. In a well-ventilated chillroom, loosely stacked, the case is chilled through in twenty-four to forty-eight hours to a temperature of about 40° F. A refrigerator car, iced, but not salted, carries the eggs to market at, or about, the same temperature, and deterioration is either greatly retarded, as in the case of hot weather eggs,

or practically prevented if the eggs are sent to the shipper before heat or age has attacked them.

Many men are now shipping their unchilled eggs in refrigerated cars,—a step in the right direction, yet some recent experiments have shown that four or five days are required to chill eggs so packed to the temperature prevailing in the car. During this period deterioration is progressing, though more and more slowly. The summer egg, as it comes now to the packing house is, at best, a very unsatisfactory product to ship on long hauls. More and more one finds the packer who is supplied with refrigerated rooms holding back a few carloads of late May or early June eggs to be sent to his clamoring customers in August or September, when the egg supply is the worst of the whole year, and when the highest grade eggs on the market are those "cold stored" in the early spring. Such held eggs are much better than the best so-called "fresh eggs" that the market affords. Indeed, we have traced eggs less than twenty-four hours old, shipped by express in a hot car nineteen hours, and found them lower in quality when they reached the market than fresh eggs shipped for a six-day haul in a refrigerated car.

The scarcity of meat and the high price of protein-rich foods makes it imperative that we handle our egg supply with as little waste and deterioration as possible. Such a need has not been experienced until recently, and the experiments which are now being made looking toward the conservation of eggs are only the beginnings of a campaign of education in which refrigeration and good handling must play the most important parts.

It is the endeavor of the packer to get his dressed poultry and eggs to market without alteration in composition; it is the aim of the carrier to deliver them to the consignee in the same condition in which he received them; up to the present time good handling and refrigeration have come the nearest to fulfilling these fundamental objects. Their era is just beginning. The acquisition of knowledge and its application to the practical problems in a practical way will preserve the quality and conserve the quantity of the national food supply.

HYGIENIC RESULTS OF REFRIGERATION IN THE CONSERVATION OF FISH AND MOLLUSKS.

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Read before the American Public Health Association, September, 1912, Washington, D.C.

The artificial application of the more modern type of cold storage processes for the preservation of fish for food purposes, occurred when the first inhabitant of the temperate zone, fishing through a hole in the ice with a primitive hook and line, allowed his first catch to freeze on the surface of the ice immediately after he experienced, for the first time, the delights of the amateur angler.

Doubtless other fishermen, before his day, had packed his catch in the available ice in the late fall and early winter and had in this way inaugurated the older system of artificial application of cold for the preservation of fish for food. Thus early did there undoubtedly occur a distinction between the two types of cold storage for the preservation of food. These consist in:

First, the application of degrees of refrigeration which will not accomplish an actual crystallization of the fluid contents of the animal's tissues. Dr. M. E. Pennington has of late been classifying this type of cold storage as "Refrigeration."

Second, the application of degrees of refrigeration to a point where a greater or less degree of crystallization of the fluids of the body takes place, and this artificial process has been recently classified by the same investigator as "Freezer Storage."

It is obviously necessary to consider refrigeration and freezer storage in more or less separate manners, for the reason that the results of the application of these two processes are not identical.

The processes of deterioration which take place in unpreserved food substances, which consist in large part in the growth of various types and forms of bacteria and allied micro- and macro-saprophytes and in the activity of digestive and other internal enzymes or ferments, are, in the processes of *refrigeration*, merely restrained by abstracting from the foods the necessary warmth requisite for the proper growth of bacteria and of other destructive microörganisms and for the activities of the digestive or liquefying enzymes or ferments.

In the case of the *freezer storage* a further process is involved, namely, varying degrees of desiccation, more or less progressive, with the degree

of reduction of temperature. It should be understood that there are forms of bacteria and micro-organisms which can grow in food substances at temperatures much below those necessary even for a certain degree of crystallization of the fluid tissue elements, but with the abstraction of moisture from the food substances in the process of crystallization in freezer storage, the bacteria meet the further restraining influence of lack of moisture. A point is undoubtedly reached in connection with every food substance and with the bacteria which are likely to be found in the same, where absolute cessation of growth can be definitely relied upon.

It cannot be said that we are as familiar with the effect of the varying degrees of reduction of temperature upon the lessening of the activity of digestive enzymes found in the various food substances as we are with the effect of reduction of temperature upon bacteria, but it is undoubtedly true that when the degrees of refrigeration have reached the point of beginning desiccation, these enzymes are very materially reduced in activity, and, in most instances, become entirely inactive if the enzyme itself is not destroyed.

Methods of preservation of food and shell-fish through *simple refrigeration* have been in use from pre-historic periods. The practical application of *freezer storage* in the preservation of these types of foods is a matter of very recent development. It is true, however, that for many years fish had been frozen solid immediately after removal from the water and had been maintained in such solid condition for varying periods by individual fishermen and corporations, but the time periods of preservation had, in such instances, been limited in most cases to a few days, and in so far as discussion of the sanitary problems involved is concerned, this older application of freezer storage can be left out of consideration.

It is a rather curious commentary on conditions in this country that the process of refrigeration, *i.e.*, freezer storage, which is the most effective has been the one which has received the most drastic criticisms, and has been subjected to the greater volume of attack, while the least efficient of the two processes, that of refrigeration, has been passed over with practically little or no comment.

It is true that fish in various stages of decomposition have been condemned by inspectors of municipal health departments, on the basis of the tests of the senses, but no comprehensive or systematic inspection of the sanitary aspects of the various branches of the fish industry, as conducted under the simple processes of refrigeration, has ever been inaugurated in any part of this country, so far as it has been possible to determine. It has been shown by Pennington and others, in connection with other food products—especially poultry—that the conditions as to feeding immediately prior to slaughter, the methods of slaughter or of killing, and of preparation for refrigeration, exercise a most important influence, and, to a large ex-

tent, determine the sanitary condition of the food products after varying periods of both simple refrigeration and of freezer storage. What has been found to be true by scientific investigation of the poultry industry is in complete harmony with the practical observations which have been made during the past few generations by the individuals engaged in the various branches of the fish industry. It has long been known by them that fish, caught during periods of active feeding, do not keep as well,—other things being equal, as those caught during what might be called the resting or non-feeding stage. It has been known to them that the deep sea fish, feeding on the crustaceæ of the colder waters of the ocean bottoms, are not as likely to undergo as rapid decomposition, other things being equal, as the so-called surface feeders. It has been known to them that in the case of the smaller forms of food fish, the less they are handled and the more rapidly they are frozen after catching, the more easily are they preserved and the better their condition when finally marketed. It has long been known to them that in the case of large fish, which cannot be rapidly and completely frozen, it is more satisfactory to promptly decapitate, bleed and eviserate the fish before refrigerating or freezing.

It cannot be said, however, that the observations of the practical fishermen have extended to a point where all the best possible processes of catching, killing, and preparing for refrigeration have been thoroughly worked out, but they have made sufficient observations to warrant the statement that the *manner of preparation* of the fish for either refrigeration or freezing determines, to a very large extent,—if not absolutely, the result which will be obtained after any given time period from the application of refrigeration, or from complete freezing.

It is astonishing, therefore, that the greatest emphasis should be placed by both a large group of officials empowered to supervise food products of various parts of America and by the general public, on the processes of refrigeration and freezing, rather than upon the processes entirely preparatory to the application of such means of preservation.

The evidences of deterioration in flesh foods can be determined by tests of two general types:

First, the tests of the senses,—that is, as to the macroscopic appearances, the presence or absence of abnormal odors, and the presence or absence of abnormal densities or conditions determined by the tactile sense, and, probably most important of all—especially in instances where the deterioration is slight in quantity, the results obtained by the taste sense after the preparation of the material as an article of food. These have generally been grouped by Doctor Wiley, in his work, under the title of organoleptic tests.

Second, the application of more or less precise technical tests to determine the histological condition of the tissues, the presence or absence and

type of the bacterial flora and the presence or absence of abnormal chemical conditions or constituents. Ultimately, various types of feeding experiments can be properly applied, the method varying with the object sought. If for the determination of the existence of decomposed products of a toxic character, the tests are conducted upon animals. If, however, it is desirable to test the nutritive value of foods which may have undergone some alteration or change, then internal tests upon human beings are appropriately employed.

Investigations of the first of the two types mentioned, *i.e.*, the organoleptic tests on fish which have been caught and prepared for preservation under varying conditions, have been extremely limited, except the observations by practical men of the industry, as already stated.

Investigations of the second of the two types mentioned above, *i.e.*, the laboratory and the poison squad tests, on fish which have already been prepared for refrigeration or freezing, or which have actually undergone varying periods of refrigeration or freezing, have likewise been limited in number. I hope to be able to report shortly the details of results of histological and bacteriological studies which have been made under my direction on fresh fish, and fish which have been subjected to various periods of *freezer storage*. The work is still under way. It is sufficient here, however, to report the conclusion which the present state of the work warrants. I have yet to find evidences of any deterioration of a histological or bacteriological character which can be traced to any changes which may possibly have taken place during any time period of freezer storage for a period of twelve months. I am not in a position to express to you definitely the results of chemical investigations which have been made by Prof. W. J. Gies upon fish taken from the same lots, under the same conditions, and on the same dates as the fish which have been supplied to me for the other types of examination. However, in view of the results obtained by me from the bacteriological and histological standpoints, and the chemical results which were obtained by Richardson, from the examination of samples of beef subjected to varying time periods of freezer storage, it will be most surprising if changes of a chemical character of any special importance will be found in the case of the freezer storage of fish for periods extending even beyond two years.

From the observations of Richardson, Pennington, and others, and those made under my own supervision, I feel warranted in making the statement that in so far as properly conducted freezer storage is concerned, flesh foods come out of storage in as good sanitary and hygienic condition as they enter it. This conclusion does not include a statement as to possible slight deterioration in nutritive value, for it does not appear to me to be possible, from the results of investigations which have been made up to the present time, to pass judgment on this point. It is generally known

and understood that, in the large majority of instances, there is a slight progressive drying effect produced by the continuation of the freezing process. There appears to be, also, some loss of flavor in many instances and with some methods of preparation prior to the application of freezing. In the case of freezer storage of fish especially, reasonably effective means are taken for the prevention of this slight but progressive tendency toward desiccation. The fish are frozen individually, or are placed in pans and are subjected to very low temperatures for a period of twenty-four to forty-eight hours. When slightly frozen, they are dipped into water and there is formed immediately a protective coating of ice, in most instances entirely preventing all opportunities for the evaporation of the tissues while subjected to the freezing storage. Owing to the evaporation from this ice coating, the re-formation of new coats of protective ice must in some instances be resorted to. Fish which have been properly prepared for such treatment, in which the protecting ice coatings have been systematically and thoroughly applied, will, upon subjection to thawing by placing the same in the ordinary refrigerator, assume the characteristics of entirely freshly caught and prepared fish and cannot be distinguished from the same by any organo-leptic tests above mentioned.

In the preparation of fish for freezer storage, it is of course highly desirable that the sanitary conditions surrounding the immediate washing and preparation of the fish for freezing be of the most modern type. The water used for the washing of the fish should be of good sanitary quality. The apparatus and rooms in which the preparations are made should be kept in as good sanitary condition as should be maintained in any establishment for the preparation and handling of perishable food products.

From what has been said, it is appropriate to conclude that aside from the sanitary inspection of the establishments engaged in the preparation for, and the freezing and holding at freezer storage, the important points for consideration rest in the supervision over the branches of the industry which are applied to food fish prior, or subsequent to, the application of cold storage processes. In short, cold storage of fish, as such, presents very few sanitary problems and such as exist can be readily controlled by infrequent inspection of establishments and their processes by well-trained sanitary inspectors. The public should be rapidly brought to the point of appreciating the fact that freezer storage processes are not in the least productive of unhygienic conditions in the foods subjected to them, but that any unhygienic conditions which may develop in foods are the result of carelessness or the application of processes prior or subsequent to the application of freezer storage.

So far, the discussion has been applicable solely to fish and has not covered oysters or shell-fish. In the case of the industries supplying us with oysters, clams and scallops, there has been but little application of freezer

storage. However, but small amounts of these types of foods reach the market without undergoing some degree of the form of simple refrigeration. The exceptions which can be noted are the instances in which oysters and clams are sent to market in the shell, but in such cases the time periods during which these foods, kept in natural conditions, will remain good and free from decomposition, are limited.

It can be said in the case of shell-fish, as in the case of fish, that the time during which they will keep, under the best possible conditions of refrigeration, is wholly dependent on the condition of the shell-fish when subjected to such refrigeration processes. Here, again, as in the case of fish, the questions of the conditions of the shell-fish as to active and inactive feeding, time, temperature and manner of washing and preparing for refrigeration, are all important.

Reference has been made to the possible effect of seasonal variations in the condition of fish at the time of catching. Although no considerable amount of investigation has been made into this aspect of the preparation and preservation of fish as food, a very considerable amount of study has been given to the effect of seasonal variation in determining the hygienic qualities of shell-fish, especially oysters.

I am presenting to the Laboratory Section a paper on the hibernation of oysters. The conclusion which I have drawn in that paper is to the effect that oysters removed from waters which are not over 40° F. in temperature are in a state of such complete closure of the shell that any disease-producing or other bacteria in the surrounding waters are entirely excluded from the tissues of the oysters, and that those which have previously gained access have been destroyed. The period of hibernation in the latitude of New York began the second week of November, 1911, and continued until May 1, 1912.

Oysters gathered during this hibernating season contain but small numbers of bacteria and are much more easily handled and distributed through the process of simple refrigeration than they are in the early months of the oyster season, September and October.

In conclusion, I wish to reiterate that from the sanitary standpoint, at least, the problems in the refrigeration or freezer storage of fish and oysters relate almost without exception to the conditions under which the food or oysters have been caught or gathered and prepared for refrigeration, and to the methods of handling these food products after they have been removed from the influences of processes of refrigeration.

COLD STORAGE IN RELATION TO THE FOOD SUPPLY.

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Read before the American Public Health Asseciation, September, 1912, Washington, D. C.

Cold storage is essentially the application of scientific temperature control in the solution of an economic problem, a practice that regulates prices without increasing them and prevents deterioration while eliminating waste.

But to the average consumer there is no hint of conservation in cold storage and little reason for the practice except that born of greed. June butter in January—spring chicken at Christmas, fresh eggs months after they were taken from the nest, summer fruit in winter weather—do these reversals of the season's horn of plenty, this carrying the products of flush markets over the time of scant production, increase the cost of food to the consumer, reduce its value to the producer or in any way injure the masses of the people who by its consumption and in its production find health and wealth?

The world's development has been along the lines of easy and abundant food production and the most progresssive nations have been the best fed. No people living in a hand-to-mouth fashion have lifted themselves above the poverty of their surroundings; no man can be an efficient member of society whose life is an alternate feast and famine. That is why the savage, ignorant of methods for conserving his food supply is still a savage.

The food supply is perishable. Fruits and vegetables are seasonable; that is, for the most part suitable for use only during the months in which they reach maturity. Meats cannot be kept after slaughter except by special treatment; even the cereals deteriorate with age and the store is depleted by vermin. And so we have a season of plenty when food fresh from the fields and orchards glut the markets and later seasons of scarcity when natural causes have destroyed the surplus of earlier months. These seasonal variations in the food supply are also subject to yearly fluctuations, for the abundant crop of one year may be succeeded by the scant crop of another. The fact that foods are perishable makes it necessary, if they are not to be wasted, to supply some adequate means for holding in check the processes of decay which if allowed to operate would make them unfit for use.

Cold storage is the modern way for arresting food spoilage. It is the latest and most successful method of storing the surplus of one season

against the want of the next, and of preventing the fluctuation of prices from below the cost of production at harvest to a point beyond the resources of the purse the rest of the year.

It is of especial interest to the health officer, both because of this phase, which, in so far as it affects the available food supply, touches the great problem of nutrition, and because of the general impression that goods held beyond what may be termed a natural period of usefulness are not suitable for food. Whether food deteriorates and to what extent should be understood by him in order that he properly may draft and enforce cold storage laws. During the last few years extensive investigations have been made to determine the deterioration of food in cold storage. The results of these investigations are the more interesting because, in some instances, at least, they upset generally accepted theories. Ever since cold storage has been practiced, cold storage chicken has been viewed with askance by the public, and cold storage food has been held accountable for every unexplained illness.

The flood of ill-designed, crudely drawn bills presented to the lawmakers of the various states during the last few years was without doubt a well-intentioned attempt to meet the demand for a careful regulation of the business of cold storage, both with the idea of protecting the health of the consumer, and in some little-understood way, reducing the cost of living. In effect, however, the passage of many of the bills suggested would have meant the destruction of a most important industry. Yet the value of cold storage is clear to everyone who has given intelligent study to the subject. Even where cold storage facilities are not available, the necessity for them is recognized, and in Canada, at least, the Government, appreciating the need for cold storage plants, has adopted the policy of subsidizing the construction of refrigerating warehouses. A committee appointed by the French Government to study the recent increase in the prices of food stuffs has pointed out that this is in no small measure due to the fact that France has as yet practically no system of holding food stuffs in cold storage. Unfortunately, men who should be thoroughly familiar with the practice of cold storage still appreciate neither its purpose nor its effect. The Commission on Cold Storage appointed by the Governor of Massachusetts to investigate the subject, addressed a circular of inquiry to secretaries of Boards of Health in the different states, asking for opinions or suggestions as to the need of regulation of the industry and the form which it should take. Twenty-one State Boards answered the inquiry and in every instance recorded a belief that legislation for the regulation of cold storage of food and food products is necessary. That the information, however, was not on the whole of great value was shown by the fact that one official recommended restricting the time limit of storage to ten days, another to ninety days, several did not think storage for more than three

months desirable. When the information of those we count as sanitary experts is so limited, need we wonder at the fear of cold storage products so long held by the average consumer? Before satisfactory legislation is enacted we must know why we need regulation and what, if any, bounds of restriction are necessary. The business should be regulated by practical laws which do not have for their purpose its destruction and which are intended rather to put a stop to the practice of the storing of food unsuitable for refrigeration, and which has, even before its entry into storage, deteriorated and become unfit for food; and to insure the withdrawal of all goods before thay have been held sufficiently long to undergo such physical change as may render them undesirable for human consumption.

The report of the Massachusetts Commission referred to recognizes in cold storage a fundamental necessity in the distribution of the food supply of the nation. It finds that cold storage enables perishable food products to be brought to market with the least possible deterioration, and that it enables the surplus of one season to be carried over to meet the demand during the season of natural scarcity. In this way, by distributing the seasonal output of perishable food stuffs evenly through the market year, it helps to equalize supply and demand. The price of the food supply to the consumer is not materially influenced by cold storage. It has been argued that the possibility of storing food products against a rising market may lead to speculation on the part of the middleman, and no doubt the facilities offered by cold storage may be abused to manipulate prices. This possibility, however, is more theoretical than actual, because of the enormous practical difficulties in the way of artificially controlling the supply of food. It is impossible to determine in advance, for instance, whether January and February will be relatively warm months as during the winter of 1911, or bitter cold months as during the winter of 1912. In 1911 the warm months brought about a very large production of eggs, and consequently eggs in storage were taken out at a loss to the owners. The possibility of such conditions obtaining acts as a deterrent to the speculator, and all data at hand shows that the manipulation of food prices is not materially increased by the practice of cold storage.

As before suggested there have been many desultory attempts to regulate the cold storage business by legislation. The Federal Government, although it has discussed the enactment of such legislation for several years, has as yet taken no action. Several states, however, have enacted cold storage laws of varying character.

In order to promote uniformity of legislation by the several states, a thing greatly to be desired in all regulative legislation, the National Association of Food Officials in 1911 gave to a committee of its members the task of drafting a model cold storage bill. As chairman of that committee, may I take the opportunity of presenting to you for your consideration,

and with the hope that it may develop helpful suggestions, some of the ideas of the committee as manifested in the first draft of its measure. The committee recognizes the need for legislation: first, to protect the public health against the sale of unfit food; second, to prevent cornering of the food supply and consequent unfair prices to the consumer, and third, to insure both to the consumer and the producer the sale of goods properly labeled. The committee defines cold storage as a warehouse for the holding of food products at or below a temperature of 40° Fahrenheit. It holds that a cold storage warehouse is an establishment employing refrigerating machinery or ice for the purpose of refrigeration where food products are stored for thirty days or more at a temperature of 40° Fahrenheit. It assumes that the states have already at hand machinery for the sanitary control of food-producing establishments, and it provides that the operators of cold storage warehouses shall obtain a license from the State Board of Health for conducting the business after a sanitary inspection has shown the warehouse to be in satisfactory condition. In the event the warehouse so licensed becomes unsanitary, it is made the duty of the State Board of Health to revoke the license. The bill provides that a complete record shall be kept of all goods entering storage and that a quarterly report of such facts shall be presented to the State Board of Health.

It is believed that such reports will prevent the cornering of the food supply. It provides that no article of food shall be placed in storage if not sound and in good condition, or unless it has been prepared in accordance with the Pure Food and Sanitary Food Laws.

The committee is unanimous in its belief that cold storage legislation should not antedate pure food and sanitary food legislation, but rather should follow and supplement it. So it is that the draft does not go into detail in the requirement of sanitary conditions, except as an incident to the issuing of the license to do business.

When food is placed in storage the date of entry is plainly marked on the container, and when removed it is again marked. No goods shall be held in cold storage for a longer period than twelve calendar months, except under certain conditions referable to the State Board of Health. It provides that goods which have been in storage must be labeled "Cold Stored" in such manner that the consumer knows when he purchases his eggs, for instance, that they are storage eggs. It provides that the State Board of Health may make all necessary rules and regulations to secure a proper enforcement of the law.

As an evidence of the honest desire of cold storage operators for reasonable legislation, it is worthy of note that the preliminary draft of this bill, except in certain minor points, is acceptable to the cold storage interests.

With the passage of adequate cold storage legislation and the development of a practice of labeling which declares the character of the goods to

the purchaser, the idea now held that cold storage is an artifice used by the speculator to force higher prices and a practice which spoils food instead of preserving it will no longer obtain.

And when cold storage is no longer feared, our markets will be widened and the food supply enlarged by the thousands and hundreds of thousands of tons of edible products which now rot on the ground for want of facilities to preserve them to such a time that they can find a profitable market.

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THE ROMANCE OF REFRIGERATION.

Since the days of Archimedes there has been nothing probably in the realm of science possessing more elements of the romantic than the history of the evolution of methods for the conservation of food by means of cold. This history contains several different elements such as primarily, the needs of rapidly growing urban populations, especially in industrial England, with their ever-increasing demands for meat and an ever-decreasing home supply, the varied efforts of amateurs and men of science to discover practical methods for the application of cold to delay the processes of putrefaction so as to make the transportation of foreign meats possible, the financial ruin of many pioneers in the work, especially Thomas Sutcliffe Mort for whom a monument is erected in Sydney, Australia, who in 1861 established the first freezing works in the world, and lastly the ultimate success of such men as Mr. G. F. Swift of Massachusetts, whose first sale of a heifer given him by his father ultimately resulted in the establishment of a meat business with a capital of seventy-five millions, with shops in four hundred cities in four continents, employing 30,000 hands and having transformed into meat in a single day in the seven packing houses 11,875 cattle, 16,355 sheep, and 34,562 hogs.

The experiments of Carré have succeeded, the dreams of Tellier have been more than realized and the very year which saw Swift go West to Chicago was made notable by Queen Victoria pronouncing a 'baron' of beef very good, sent over to England from New York as 'chilled' meat by T. C. Easton & Co. England saw prices from 1851 rise by decades till 1882, when the S. S. *Dunedin* took the first really successful cargo of frozen meat from Australia, from in 1851—4¾d; 1861—6¾d; 1871—8d, and in 1881—8¼d. per pound, while the imports of mutton rose from 1,000,000 lbs. in 1885 to 13,000,000 in 1910.

But we of the American continent require no historical illustrations to

make clear what science hs brought about through the art of refrigeration in maintaining an equilibrium in the supply of meats and other animal foods. Both the United States and Canada are beholding a phenomenon in social evolution, since the former in the census year 1910 has seen an urban increase in population in ten years from 30,000,000 to 42,000,000 with but 4,000,000 added to her rural population, while the latter saw in 1911 with 1,700,000 added to her total population in 1901 of 5,250,000, an urban increase of 1,200,000 and a rural of but 500,000. Production in both countries has been overtaken by consumption of food, while year by year sees, through the use of cold in the preservation of limited food supplies, the only known means of preventing for the moment an actual scarcity and famine prices.

The scientific distribution of food supplies so as to maintain an even balance between production and consumption is, today, urgently demanding the most serious attention of statesmen, economists and sociologists; agricultural science, while doing something towards increasing soil productiveness, is still unequal to meeting the crying demand for supplies; mechanical science too, while daily devising new means for lessening the cost of production, has as yet failed to supply the remedy, and, it must with regret be said that, until all these several agencies have solved each its special problem, the very existence of the people of these two great agricultural countries is forcing the science of refrigeration forward by leaps and bounds as the one remaining immediate means of maintaining something like an adequate supply of food, though it be in some articles almost at famine prices, for the 100,000,000 mouths requiring to be fed on the North American continent.

A STEP FORWARD.

The recent announcement of Doctors Anderson and Frost of the Public Health Service to the effect that they have been able to duplicate and confirm Doctor Rosenau's experiments with regard to the transmission of anterior poliomyelitis to monkeys through the bites of the barn fly (stomoxys calcitrans) will be received with enthusiasm.

While the work of these observers does not necessarily indicate that this disease is not transmitted in other ways, as, for example, by contact, it at least gives health authorities some definite information with regard to the taking of steps to prevent the spread of the disease, and it is safe to say that in those communities where the disease exists, or has existed, renewed efforts will be made to do away with breeding places for flies.

In this connection it is interesting to recall the cycle through which the fly question and the ability of flies, notably the common house fly, to transmit disease has passed. Within the last year or two there has been a

noticeable tendency on the part of some health officers to discredit, at least in part, the ability of the house fly to carry disease.

The investigations of Rosenau, Anderson and Frost again emphasize the particular necessity for the proper disposal of horse manure in such a way as to prevent fly breeding, both in urban and rural populations.

The AMERICAN JOURNAL OF PUBLIC HEALTH extends to Doctor Rosenau and also, of course, to Doctor Richardson and the workers of the State Board of Health of Massachusetts, its warmest congratulations. It seems probable that this discovery will be of great service and benefit to mankind. While not indicating that infantile paralysis will be exterminated, it does furnish us with much needed ammunition to fight this dread disease. Perhaps the application of the principles of prevention indicated by the discovery will go far towards preventing the panic which at times arises in localities where poliomyelitis appears. The mystery of anterior poliomyelitis is in part solved. The work of these investigators is another triumph for that most valuable aid to mankind—animal experimentation.

PUBLICITY AND HEALTH ADMINISTRATION.

That this is an age of publicity is making itself apparent even to the lowes wits of the community. Even the great corporations of the day are waking up to the fact that the "white light of publicity" is not necessarily a disagreeable obligation, but may be made an asset of value. It is an indispensable preliminary of legislation and a necessary accompaniment of effective administrative control.

It is here that many of our Health Departments fail lamentably. It is doubtful if there is any aspect of our state or municipal governments less understood by the public as to aims and methods than the Departments of Health. They are apt to be viewed with suspicion and antagonism by physicians and with apathy and neglect by the laity.

Particularly in the smaller communities failure to act by the authorities is explained by lack of public support. The fault is often found to be that of the Department itself. The public is not taken into its confidence and we see on every hand the discouraging spectacle of the Health Officer plodding slowly behind instead of leading and stimulating his local public opinion. An organized system of publicity should be in operation in every Health Office in the country. The facility with which the atmosphere clears as knowledge appears is often astonishing. Wherever intelligently tried, whether in a great metropolis or in towns of smaller population, the results are always worth while.

THE EFFECTS OF TEMPERATURE AND HUMIDITY ON FATIGUE.

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Read before the Section on Hygiene of Occupations of the Fifteenth International Congress on Hygiene and Demography, Washington, September, 23, 1912.

The physiologist in his fondness for investigating internal mechanisms is prone to overlook the important fact that the living body exists in the midst of a multitude of external conditions. These conditions furnish stimuli to the living tissues, augmenting or diminishing their actions, and such stimuli play an important part in determining the activities and correlations of the internal mechanisms. The organism as a whole in the midst of its environmental conditions must establish for itself at each successive moment a balance in the work of its various parts. If one of the conditions is altered this balance is by so much disturbed. Within limits, and even within wide limits for brief periods, such a disturbance is borne with impunity: a readjustment to the altered situation occurs; a new balance is struck; and no harm results. But if the limits be much or long surpassed the normal adaptation gives place to a pathological state which is detrimental to the organism.

Of the two environmental conditions here in question, the temperature and the humidity of the air, there exists a certain medium range of variation within which the human body is capable of performing its best work. Even when adapted to this optimum it may be subjected for a considerable period of time to a high temperature or a low temperature, to a high humidity or a low humidity, without serious disturbance of its organic balance. One need not be a man of science to realize this truth; one needs not to live outside of our own America, famed for its fitful climate. But prolonged exposure to extremes of these conditions does not conduce to the continuance of a normal physiological state. The effects of a low temperature and a low humidity have not been studied as fully as have those of the opposite extremes, and these two latter have especial significance when they are associated with one another. I propose therefore to confine myself to a discussion of the physiological and pathological relations of the living body when subjected simultaneously to high temperature and high humidity.

We may observe these relations on many of the hot and humid summer days in our American cities. We may observe them when one who is adapted to a temperate climate goes to live in the tropics. They are well illustrated in various industrial occupations, such as mining, baking, laun-

dering, and some varieties of cotton weaving. The effects of exposure to the atmosphere of these situations are many and various. The bodily mechanism for resisting external heat is at once brought into action. The blood vessels of the skin become dilated and charged with blood, the skin becomes heated, and the sweat glands become active. From the skin there occurs a loss of bodily heat by radiation, conduction, convection and the evaporation of perspiration. The loss of heat by these processes, amounting, according to Rubner,* to 95.25 percent. of the total heat loss, may suffice for a time to keep the bodily temperature at its normal level. In proportion, however, as the temperature of the air approaches or surpasses that of the body and the humidity of the air is sufficient to prevent the evaporation of sweat, loss of bodily heat by the customary channels becomes lessened. Without adequate means for eliminating the heat that is being constantly produced within, the internal temperature rises and a febrile condition results. Such a state is reached the sooner, the more mechanical work is performed and the more heat is thereby produced. Its oncoming is favored also by a lack of movement in the air. With a continuance of the unfavorable environmental conditions a simple rise of internal temperature may pass into a higher fever characteristic of simple heat prostration, or a moderately severe heat stroke with a temperature up to 40.6°C. (105°F.), and finally into the hyperpyrexial or intense form of heat stroke, in which the bodily temperature has been known to rise to the phenomenal height of 47.6°C. (117.8° F.). That the elevation of bodily temperature is the result of an elevation of external temperature and humidity combined has been well shown by various British authorities† whose information is drawn partly from laboratory experiments and partly from observations in mines and factories. Haldane‡ summarizes the results of his observations as follows:

"These experiments proved that in very warm air it is the temperature indicated by the wet-bulb thermometer (not the actual air temperature as shown by the dry-bulb thermometer, nor the amount of moisture in the air, nor the relative humidity) which determines the ill-effects produced. With a wet-bulb temperature exceeding 88° to 90° [F. = 31° to 32°C.] in fairly still air the body temperature begins to rise, even in the case of persons stripped to the waist and doing no work; and when once started this rise continues until symptoms of heat stroke arise, unless the person leaves the warm air. In the case of persons doing muscular work, the rise of body temperature is much more rapid and begins at a much lower wet-bulb temperature. It will, for instance, begin (in persons stripped to the

* Rubner: Lehrbuch der Hygiene, 8th Edition, 1907, p. 90.

† Reports of the Departmental Committee on Humidity and Ventilation in Cotton Weaving Sheds, London, 1909 and 1911.

‡ Haldane: Report of the Departmental Committee, etc., Appendix III, p. 218.

waist) at a wet-bulb temperature of about 80° [F. = 26.7°C.] in still air with moderately hard muscular work, so that hard and continuous work is impracticable at wet-bulb temperatures of over 80° in still air. There is no doubt that when ordinary clothes are worn, serious rise of body temperature occurs at a still lower wet-bulb temperature. Soldiers marching in uniform are, for instance, liable to heat stroke at wet-bulb temperatures of under 70° [F. = 21°C.]."

A second striking effect of a combined high temperature and high humidity is a disinclination or actual inability to perform active muscular work. Beginning as a mere inertness, accompanied by sleepiness, which may readily be resisted for a time, it may pass into a genuine condition of fatigue, and ultimately into the exhaustion of heat stroke. Haldane* says of the Cornish miners of tin and copper: "They do not . . . seem to be able to do more than a limited amount of work. The leisureliness of all work in the mine is in very striking contrast to what may be observed in any ordinary English colliery of about the same depth." Pembrey,† after studying the effects of warm moist temperatures upon himself, medical students and soldiers, concludes: "The results show definitely that a man is much less efficient in a warm moist atmosphere. . . . A man can do far more work with less fatigue at a low wet-bulb temperature than at a high one." Pembrey and Collis,‡ in speaking of the physiological effects of the warm, moist atmosphere of cotton weaving, say: "The natural tendency is for the nervous system to become less active and for muscular work to be diminished. In a weaving shed, however, the machine sets the pace and the worker must neglect the dictates of his sensations, which are the natural guardians of his health and well-being. . . . It is not surprising, therefore, that at the end of a day's work many of the weavers complain that they have no energy left, have no great desire for food, and need only drink and rest." Boycott§ says of mining in hot moist air: "My observations on miners . . . lead me to conclude that their power of doing work under these circumstances is quite small." Cadman,¶ professor of mining in Birmingham University and late H. M. Inspector of Mines, gives more detailed observations to the effect that from about 25° C. (77° F.) wet-bulb reading, exertion begins to be accompanied by depression, and disinclination to work increases rapidly with an increasing wet-bulb temperature. At 27.8°C. (82°F.) "if clothes be removed and maximum body surface exposed work can be done providing current of air is available." At 29.4°C. (85°F.) "only light work is possible"; and at 35°C.

* Haldane: Journal of Hygiene, 1905, V, p. 498.
† Pembrey: Report of the Departmental Committee, etc., 1909, Appendix IV, p. 221.
‡ Pembrey and Collis: Second Report of the Departmental Committee, etc., 1911, Appendix III, p. 24.
§ Boycott: Report of the Departmental Committee, etc., 1909, Appendix V, p. 222.
¶ Cadman: Report of the Departmental Committee, etc., 1909, Appendix VIII, p. 225.

(95°F.) "work becomes impossible." Stapff* observed in the construction of the St. Gotthard tunnel that the laborers, working in an atmosphere often completely saturated with moisture and with a temperature rising at times beyond 30°C. (86°F.) as measured by the dry-bulb thermometer, experience not only great discomfort, but indifference, enervation, weariness and exhaustion. These direct statements are supplemented by the testimony of many industrial workers and observers of industrial conditions to the effect that combined high temperature and high humidity cause not only bodily discomfort but lessened power of labor. All who have experienced such conditions cannot fail to agree with such testimony.

But the lessened power of labor under such circumstances may be real or only apparent. The sensations of fatigue which are undoubtedly present may diminish the amount of labor performed; but sensations of fatigue are often misleading and do not necessarily signify the presence of the actual physical basis of fatigue. Unfortunately there seems to have been made no exact comparative studies of the actual amount of labor which the human body is capable of performing under these abnormal conditions. This is but one instance of a lamentable lack of exact information regarding the capabilities of the body under different environmental conditions. This lack can be supplied only when we have devised adequate methods of testing the working powers of the living individual. Patrizi† has indeed shown that human muscles when subjected to localized hot baths, as by the immersion of the arms in hot water, and then stimulated electrically, undergo early fatigue and rapid exhaustion. This result is in harmony with those of Gad and Heymans‡ and others, who find that the excised muscles of frogs become rapidly fatigued when warmed. From all the available evidence therefore it seems probable that the actual physical basis of fatigue is present in a body working in a hot and humid atmosphere. A more detailed analysis of the physical and chemical conditions of such a body confirms this conclusion and, I venture to think, throws considerable light upon this hitherto obscure subject.

When in a hot and humid atmosphere the blood vessels of the skin are dilated and overcharged with blood, the brain and spinal cord among other organs are rendered correspondingly anemic. This is sufficient of itself to account largely for the feeling of weariness, the indifference and apathy toward laboring that are then present. The changed bodily sensations and the general bodily discomfort may also tend toward the same end.§ But if the stage of elevated bodily temperature be reached, the internal conditions are still more radically changed. A febrile state, especially

* Stapff: Archiv für (Anatomie und) Physiologie, 1879, Supplement Band, p. 91.
† Patrizi: Archives italiennes de biologie, 1893, XIX, p. 105.
‡ Gad und Heymans: Archiv für (Anatomie und) Physiologie, 1890, Supplement Band, p. 59.
§ Hough: American Journal of Public Hygiene, 1910, XX, p. 267.

when pronounced and long continued, affords unusually good chemical conditions for the oncoming of fatigue. One of the striking metabolic accompaniments of the fevers that result from bacterial invasion of the living body is an increased excretion of nitrogen, which is derived, as is inferred from the work of various investigators, from an increased destruction of the proteins of the tissues, probably due largely to the direct action of the higher temperature upon them. This abnormal destruction of proteins appears to occur not only in fevers of bacterial origin but in the hyperthermy produced by hot baths and in other ways. Schleich,* Formanek,† Edsall‡ and others, have found this to be the case. It was long ago maintained that along with the increased destruction of proteins in fevers there is an incomplete oxidation of intermediate metabolic products. In this connection, it is interesting to recall that Mandel§ finds purin basés to be increased and uric acid to be decreased in quantity in febrile urine. Furthermore, Geppert,¶ Minkowski|| and Kraus** argue from the diminished quantities of carbon dioxide in the blood and from other facts that there occurs an acid intoxication during fevers. Ammonia, indicating also the production of acids, is increased in output.†† Acetone and even diacetic and oxybutyric acids have frequently been found in febrile urine.‡‡ While it is still in doubt whether these acetone bodies arise from destroyed proteins or from destroyed fats, the fact of their existence as intermediate metabolic products seems clear.

Whether analogous changes occur in the hyperthermy resulting from exposure to a hot and humid atmosphere has not yet been sufficiently investigated, but it seems altogether probable that in such cases there is at least a great disturbance of metabolism. The theory of auto-intoxication as the essential causative factor in insolation was first suggested by Vincent in 1888.§§ It was adopted by Van Gieson,¶¶ Levene,||| and Lambert*** in their investigations of sunstroke during the extraordinary occurrence of that disease in the city of New York in the summer of 1896. The symptoms of the disease suggest strongly the presence within the body of an acute poison. Levene found that the blood serum of two patients suffering from

* Schleich: Archiv für experimentelle Pathologie und Pharmacologie, 1875, IV, p. 82.
† Formanek: Sitzungsber. d. Kais. Akad. d. Wiss. Math. nat. Cl., Wien, 1892, 101, p. 278.
‡ Edsall: Transactions of the Association of American Physicians, 1909, XXIV, p. 625.
§ Mandel: American Journal of Physiology, 1904, X, p. 452; 1907, XX, p. 439.
¶ Geppert: Zeitschrift für klinische Medizin, 1881, II, p. 355.
|| Minkowski: Archiv für experimentelle Pathologie und Pharmacologie, 1885, XIX. p. 209.
** Kraus: Zeitschrift für Heilkunde, 1889, X, p. 106.
†† Erben: Zeitschrift für Heilkunde, 1904, V, p. 33.
‡‡ MacCallum: Archives of Internal Medicine, 1909, II, p. 504. Also Harvey Lectures, 1908–9, p. 27.
§§ Vincent: L'hyperthermie. Thèse de Bordeaux, 1887–88. Number 8.
¶¶ Van Gieson: New York State Hospitals Bulletin, 1896, I, p. 475; Medical Record, 1900, LVII, p. 1134.
||| Levene: New York State Hospitals Bulletin, 1897, II, p. 357.
*** Lambert: Loomis and Thompson's "A System of Practical Medicine," 1898, article on "Insolation"; Medical News, 1897, LXXI, p. 97.

the disease, as well as the urine of convalescent patients, was acutely toxic to rabbits; and although he was unable to demonstrate any increased nitrogenous metabolism he came to the conclusion that the symptoms of sunstroke result from an auto-intoxication due to some kind of a pathological decomposition of tissue. Van Gieson described histological changes in the nerve cells of the brain and spinal cord which are closely similar to those produced by various poisons, such as other auto-intoxicants, bacterial toxines, alcohol and lead. Analogous lesions have been observed in either insolation or artificial heating by Goldscheider and Flatau,* Marinesco,† and Amato.‡ Various investigators § have found that when the temperature of the body has been raised, either experimentally or in insolation, the alkalinity and coagulability of the blood may be diminished. Another fact of significance is the unusually early appearance of rigor mortis and decomposition after death from insolation,¶ which suggests that an acidity may have developed in the muscles. From these various observational and experimental data it may be inferred, if not with certainty at least with a high degree of probability, that the subjection of a body to an external temperature and humidity sufficient to raise the internal temperature to a pathological degree causes metabolic changes, the nature of which is not yet known but which interfere profoundly with the normal working of internal mechanisms.

Fatigue is a physical phenomenon, a lessened power of work, which has as its basis certain metabolic phenomena. The two chemical causes of fatigue have long been recognized as the diminution of substance that is essential to activity and the accumulation of metabolic products that are toxic or depressing to the tissues. Of these fatigue substances carbon dioxide and lactic acid appear to play a prominent rôle in the production of normal fatigue.|| It is probable, as I have elsewhere maintained,** that these are but types of other metabolic substances which act similarly. This is seen most clearly in certain pathological conditions. It is well-known that in diabetes, for example, there exists an acid intoxication conditioned by the presence in the blood and tissues of β-oxybutyric acid and other acetone bodies. I have been able to show that when β-oxybutyric acid, either free or as a salt, is administered by irrigation to a muscle, the muscle behaves as if it had been fatigued by exhaustive labor, and I have explained

* Goldscheider und Flatau: Fortschritte der Medizin, 1897, XV, p. 245; do., 1898, XVI, p. 124. Cf. Moxter, do. p. 121, and Goldscheider und Brasch, do. p. 126.

† Marinesco: Comptes rendus de l'Academie des Sciences, Paris, 1906, CXLIII, p. 853.

‡ Amato: Virchow's Archiv, 1909, CXCV, p. 544.

§ Wood: Sunstroke, 1872, pp. 86 and 93; Thermic Fever, Pepper's System of Medicine, 1886, V, p. 392. Lambert: *Loc. cit.*

¶ Lambert: *Loc. cit.*

|| Lee: Journal of the American Medical Association, 1906, XLVI, p. 1491; also Harvey Lectures, 1905–6, p. 169; American Journal of Physiology, 1907, XX, p. 170; Popular Science Monthly, 1910, XXVI, p. 182.

** Lee: British Medical Journal, 1906, II, p. 1806.

the well-known proneness to fatigue of an individual suffering from diabetes as due in considerable part to the direct action on the tissues of β-oxybutyric acid and perhaps other associated pathological fatigue substances. It is probable that a similar explanation will hold for inanition, the pernicious vomiting of pregnancy, and the various other instances of acid intoxication, all of which are characterized by marked fatiguability. What has been said of β-oxybutyric acid is equally true of indol, which likewise is depressing to muscle and the presence of which in abnormal quantities within the body is associated with a similar tendency to fatigue.* It has been maintained † that the inability to perform continued labor that is so pronounced in neurasthenia rests likewise upon analogous metabolic causes, the identity of which has not yet been established. I think it probable that future research will greatly extend our knowledge of the metabolic bases of fatigue. Especially do I look for such a rôle to the intermediate metabolic products which may be present in abnormally large quantities in various pathological states. Such a conception too appears to me to afford the most probable explanation of the fatigue that appears to be present when the individual is endeavoring to labor in an atmosphere at a high temperature and a high humidity. Here he has to contend not only with his normal fatigue substances, but with the pathological substances that result from the peculiar conditions of his labor.

But there is a further factor to be considered. More than a hundred years ago Alexander von Humboldt ‡ observed that heat increases the action of various chemical substances on various forms of living substance, such as the heart and the motor nerves. This has since been studied in many ways by many investigators, such as Hermann,§ Kronecker,¶ Luchsinger,|| Lauder Brunton and Cash,** Richet,†† and others, and it has become recognized as a general law, that the temperature at which poisons act upon living substance is a factor, as in other chemical phenomena, in determining the degree of their action—at a higher temperature their action is more intense. There seems to be no reason why this law should not apply to the case under consideration. This suggestion has indeed been made for normal fatigue substances by Patrizi ‡‡ to explain the ready fatiguability of human muscles submitted to localized hot baths. With even greater weight

* Lee: in Herter's The Common Bacterial Infections of the Digestive Tract, 1907, p. 254.

† Cowles: Neurasthenia and Its Mental Symptoms, 1891; cf. also Ballet; Neurasthenia, translated by P. Campbell Smith, 1911, translator's preface, p. XIX.

‡ von Humboldt: Über die gereizte Muskel-und Nervenfaser, 1797, II, p. 218.

§ Hermann: Archiv für (Anatomie und) Physiologie, 1867, p. 64.

¶ Kronecker: Archiv für (Anatomie und) Physiologie, 1881, p. 357.

|| Luchsinger: Thermisch-toxicologische Untersuchungen, in Grützner und Luchsinger's Physiologische Studien, 1882, p. 33.

** Lauder Brunton and Cash: Journal of Physiology, 1882, IV, p. 1.

†† Richet: La chaleur animale, 1889, p. 213.

‡‡ Patrizi: *Loc. cit.*

it can be applied to the human being laboring under the disadvantageous conditions of excessive temperature and excessive humidity. Normal and pathological fatigue substances are here present in solution in an overheated body. If they are toxic at normal degrees of temperature, their toxicity is more pronounced at higher degrees, and in proportion as mechanical work is performed and internal temperature rises, the more is working power lessened.

I may, therefore, summarize my thoughts as follows: When an individual is subjected to an atmosphere that is charged with an excessively high temperature and high humidity, his bodily temperature is raised, his working power becomes limited, and there is an early oncoming of fatigue. In addition to the normal fatigue substances there are present other substances, products of an abnormal metabolism, perhaps of increased protein disintegration, which likewise act as fatigue substances. Both the normal and the pathological fatigue substances act toxically to diminish the activity of the tissues, and such fatiguing action is rendered greater by reason of the abnormally high internal temperature that is present.

If these considerations, presented from a purely scientific standpoint, are worthy, their significance ought to be more than merely academic. Industrialism presents numerous instances in which human beings are obliged to labor under the conditions here outlined. Constant submission to these conditions is detrimental to the well-being of the individual and ultimately of the race. This is an unnecessary situation, which sooner or later is bound to be relieved. It is the duty of men of science not merely to discover the conditions under which men labor, not merely to show how an environment is detrimental, but to use their influence to make of labor a physiological rather than a pathological exercise.

PUBLIC HEALTH—PAST AND FUTURE.

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Proper public health measures—by which I mean the possible and practical measures which a government may enforce on an assured basis of proven knowledge—hardly existed until forty years ago. Twenty years ago, the confusion on the theoretical sides of medicine and physiology were so great that there was little of real logic or reason in the public health teachings of the day. Even now, one often sees advocated as public health measures proceedings, which however valuable from aesthetic, cultural or even true sociological standpoints, are yet rather the result of a vague desire for what is believed to be racial advancement, than any real technical grasp of the direct relations of causes and effects connected with disease.

The public health men of yesterday were dealing with exactly the same broad facts that we are; but, dominated by an environmental doctrine, they interpreted them blindly, as we see now. Malaria was associated with swamps, influenced by prevailing winds, entered by the lower rather than the upper windows, was more likely to be contracted at night and so on. As observers, the men of yesterday were perhaps more acute than we. But they had a doctrine—and they marshaled their facts willy nilly into the doctrinal fold—the doctrine of environment. They saw the mosquitoes but did not consider them. They sought an environmental cause, not a biological one.

This doctrine made diphtheria a matter of soils; typhus fever a matter of "poor sanitation," starvation and poverty; typhoid fever a swamp and slough disease; tuberculosis a matter of the dark and damp. Facts that did not fit with these theories were glossed over or left to one side for future consideration.

Today we are in danger of a like doctrinal obscuration of actual observations. The immunologists have done so much that it is almost the fashion to put off energetic public health work on the lines we know to await that glad day when disease will disappear because all its possible victims have been immunized. A further and wholly unwarranted assumption is too often unconsciously made,—*i. e.*, that this longed for immunity, while it may indeed depend sometimes on the use of specific immunizing agents like smallpox vaccine, antityphoid vaccine, etc., can be cultivated by good food, proper exercise and the outdoor life—an idea which in the form it is usually held and presented has but a modicum of truth if any.

Lest I be accused of setting up a straw man to knock down again, let

me say that exactly these ideas have been expressed in high American and Canadian quarters within six months. Yet what are the facts?

The immunity to measles acquired by an attack of measles is specific—it does not protect against scarlet fever, diphtheria, smallpox or even German measles. Very few persons are born with a permanent immunity to measles. Yet almost all are born with a temporary immunity to it, lasting during the nursing period. This infantile immunity has been explained as due to immunizing substances derived through the milk from the mother. I have suggested, and suggest again now, that it would be of intense interest to discover from records of maternity hospitals or other similar observations, whether or not this immunity of nursing infants to measles is present or absent in correspondence with the presence or absence of immunity in the nursing mother or wet-nurse.

The fact that the nursing child does not suffer from measles even if the mother be suffering from measles herself—and hence was not previously immune—does not settle the question; for it is quite possible that the dosage of immunity-conveying material in the milk may be greater than the dosage of pathogenic organisms the child receives *per oram* otherwise. Here also might be suggested the experimental use of mother's milk from non-immunes and from immunes for the treatment of older children suffering from measles.

In whatever way the nursing infant is immunized to measles, the fact that he is immune seems well established. But this immunity is not a general one—it does not protect him against smallpox or tuberculosis. Hence, the protective agent, whatever it may be, which protects against measles, is not the protective agent, whatever it may be, that protects against smallpox. But the smallpox protective agent may be added to him by vaccination. Thereafter as he grows up, the measles immunity which he had at birth disappears, the smallpox immunity which he acquired continues, and both these are true absolutely independently of age, sex, color, feeding, fresh air or any other known bodily status. Surely immunity to the infectious disease is not due to general vitality, or upbringing, but to a specific thing differing for each disease, and not susceptible of increase or diminution by mere environment.

If we turn now and look into the future to see before us the ideal man, carefully bred, carefully raised, in accord with the true "rules of hygienic living" of which we talk so much and know so little, can we expect him to be not only of magnificent physique and brain, but also naturally immune to smallpox, tuberculosis and so on, because of that physique, because of the careful regimen, because of pure water, fresh air, good food?

We do not know of course. But if we dare draw analogies with the high-bred and greatly-cared-for stock of the modern scientific farmer, the prognosis is bad. To the agricultural student we must turn to learn the

practical hygiene of the well and of health—we have not studied it in the human sufficiently as yet. Do we find high-bred, well-cared-for stock more resistant to infection? On the contrary, they are less resistant. Scrub cattle roughing it on the prairie will stand more than the most magnificent specimens of their race reared carefully amongst the best surroundings. Nor is this true of animals only. Even amongst plants the same thing appears to be true. If resistance is a part of general well-being and a logical result of observing the laws of health, these facts are at present inexplicable. On the other hand, if resistance be a matter of intended or accidentally acquired specific immunity, the reaction of the body to an alien substance, specific for that substance, it is possible to understand it all.

What, then, is the outlook for the future? It seems to me that we may venture two hypotheses—two possible modes of reaching freedom from disease.

The one is that which, perhaps, as suggested in substance by Theobald Smith, is working itself out today—the isolation of severe cases of disease, with neglect of mild ones, tending *in the long run* to eliminate the virulent strains of organisms and to propagate the mild ones. The latter diffuse immunity through the community, in hit or miss fashion it is true, but still do gradually immunize a large number of people through mild attacks. This in turn cuts down the severity of epidemics and in time may result in a general modification of the disease.

It is true that diphtheria is seldom now the frightful disease of thirty years ago, even when fatal; and whooping cough is rarely seen in the severity that older epidemiologists describe.

The other view is this—There is no advantage in immunizing a race against a non-existent disease. Why not make the disease non-existent and do away with the need for immunity? Why not abolish infectious diseases and send the race on, unprotected, but safe because there is nothing to be protected from?

One hundred years ago the Western father who did not teach his son to shoot was neglecting an elementary essential precaution against the Indians who beset him on every hand. It was unheard of—a crime against the white race. So now, with smallpox stalking abroad, the child, who is carelessly left unvaccinated is being treated just as badly as the boy of one hundred years ago who was not taught to shoot. But we removed the Indians—why not remove smallpox? The first was a brutal movement—the second a most exalted one. Why should we immunize for indefinite years to come at considerable expenditure of time and money when a very few years' concerted effort would abolish infection? Compulsory vaccination is good—but has never been carried out except under a military régime. Why not abolish smallpox and do away with vaccination altogether? Antityphoid inoculation is good, but it is as hopeless a

method of getting rid of typhoid fever as vaccination has proved to be in getting rid of smallpox.

Both have saved innumerable lives and prevented innumerable cases; but neither promises to abolish either disease, while the existence of vaccination gives health officers a valid excuse for neglecting to stamp out vaccinatable diseases—on the ground that no one need have them if they will protect themselves. True—but it ought to be unnecessary to protect one's self. No one need be killed on a grade crossing, but that is no reason why grade crossings should be permitted. The future demands not restriction of disease, but abolition; not the protection of the individual by individual effort, but the removal of the need for protection by proper governmental action.

THE TREND OF MEDICO-SOCIAL EFFORT IN CHILD WELFARE WORK.

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Read before the American Public Health Association, September, 1912, Washington, D. C.

I am very glad to have this opportunity to discuss what seems to me to be the trend of medico-social effort in Child Welfare work before this group of physicians, sanitarians, and laborers for the public health, because, as I understand it, this is the first time the social worker has been formally admitted into your councils, and because *as* a social worker who has been thrown into close contact with scores of physicians and health officers, I have the deepest appreciation of the work you have done and of the tremendous import of your attitude of mind and your influence, not only on Child Welfare and health problems in general, but on the social good.

First of all, let me say that the problem of Child Welfare, in the sense that I understand and use the term, is a health problem not to be dissociated from, and, indeed, from the practical standpoint of its solution, synonomous with, the general problem of public health. Because, however, of its quick appeal to the sympathy and understanding of the general laity, growing out of the fact that it is now generally recognized that the children of today are the men and women of tomorrow, and that work in developing strong and robust boys and girls is more profitable than work in mending conditions of adult sickness and disease, *I* believe that the surest and quickest way to public health is through Child Welfare work; and that in building the machinery for this work we are building the machinery for carrying on all those other forms of social and medical activity which ultimately will convey health to every home.

In the Child Welfare movement, as in all other movements for public health, two forces have been particularly active—those embraced by the medical profession on the one hand, and those of the so-called social worker on the other. At first the line of demarcation between these two forces was quite distinct. Of late years it has been growing less so. Students of sociology today clearly recognize that most of the problems which social and philanthropic agencies are endeavoring to solve are health problems, while on the other hand, the fact is also beginning to be apparent that most of the diseases which physicians and health authorities are treating and endeavoring to rectify have their origin in social causes. Reflect for a moment on the work which is being initiated and carried out by such

agencies as are found in the United Charities Building in New York City. The activities of the Committee on the Prevention of Tuberculosis, of the New York Milk Committee, of the Housing and Pure Food Committees and the Committee for the Prevention of Blindness—the very names indicate how deeply the philanthropic world is delving in health problems. On the other hand, consider that most of this effort, begun in purely a charitable or philanthropic spirit, has found, or is finding, its way into our health departments; that many of our leading hospital experts, recognizing that they cannot even properly diagnose and prescribe without understanding the social conditions under which their patients live, are establishing bureaus of social service in the charge of non-medical workers; and that a layman—a social worker—at this moment is directing Boston's largest dispensary. Consider these things, I say, and you will agree with me, I think, that health work is fast developing beyond those limits wherein the medical practitioner has long been wont to hold uninterrupted sway.

Slowly but surely a new concept is dawning in the minds of those who are working and thinking on these problems. Slowly but surely we are coming to realize that even the ethical character of a people has its basis in physiology; that this thing we call health is the foundation and source of civic righteousness; and that anything which tends to deprive any man or woman, youth or maiden, boy or girl of an essential to its physical growth or development is a wrong not only physically, but intellectually, morally and spiritually against this and succeeding generations.

I say that physicians and workers for the public health are *beginning* to grasp this concept. Perhaps I should say they have as yet only "sensed" it. Certainly they have taken no steps to meet the new problems which action in conformity to such a concept would logically involve.

The reason for this is, of course, purely evolutionary. In the progress of human events circumstances of growth and development inevitably have compelled us to do the thing nearest to us first, without questioning and, indeed, without knowing at the moment, what lay beyond. For this reason medical and social efforts, even at this supposedly advanced stage of thought along health lines, are still largely occupied with remedial and corrective measures. Prevention is practiced, but, after all, practiced on a restricted scale. Causes of tuberculosis, infant mortality and the like have been worked out, and more or less clearly defined programs to eliminate these evils have been formulated; but the pressure of each man's work and the lack of constructive leadership have prevented us up to the present moment from carrying out the broader forms of prevention which recognize that the solution of each separate problem is inextricably bound up in the solution of every other problem; and that the *whole* problem cannot be solved without concerted and organized effort, not only along medical, hygienic and sanitary lines, but along every known line of social effort.

That this is so, and that greater progress towards organized prevention in public health work has not been made, is a thing which the social worker must be given a chance to rectify; for he it is, with his special experience and training, to whom we must look for guidance when the problem of health shifts to social grounds.

In making this statement I do not mean to imply that the physician, as a leader in health work is necessarily to be supplanted by the social worker, nor do I fail to recognize the tremendous contribution which he has made along lines other than those which are strictly medical. In the very social field of which we are speaking his researches and discoveries have been unquestionably foundation stones. Without his self-sacrifice and generous contribution of time and service most of our chartiable and philanthropic activities which have since developed along the broader lines of social and community effort would have been impossible. Without his activity and enthusiasm social progress could not have advanced to the point which it has reached today.

Still there *is* a very distinct difference between the practice of medicine and social work, and the time has come when for the sake of efficiency in our health movements this difference should be made clear.

Perhaps it will help, in setting about this task, if we first understand and appreciate what are now becoming recognized as the essential steps to all social growth.

These steps are as follows:—

First, there is the laboratory work—the work of study, investigation and research to find out the causes of bad health and deleterious conditions and to learn what must be done to remove these causes.

Next, there is the work of education and publicity—of telling others the truths learned in our laboratories and by study, investigation, and research—of multiplying the number of individuals who know what ought to be done to remove the causes of bad health and deleterious conditions, and of creating a public demand that it *shall* be done.

Lastly, there is the work of organization—the actual doing of the thing that ought to be done.

Let us now take the problem of Child Welfare and see what part the physician, what part the social worker, has played and must in the future play therein.

No one will deny, I think, that the physician, by discovering and pointing out the immediate causes of sickness, diseases and death among babies, give the first great impetus to the Child Welfare movement. His work in this connection is that of the specialist, the student, the investigator. Dealing with bodily disease among babies he naturally was first to ask the question "why?" when stunted and distorted little beings came beneath his notice; and it was not long before an answer was evolved.

Once this preliminary medical research work had been done, however,—once the relation between specific diseases and their immediate causes had been established—new problems arose. Take for example, the question of the milk supply. All of us know the relation between bad milk and intestinal diseases among babies. Physicians discovered this relation for us, and by doing so showed us the necessity of a clean milk supply. This accomplished, however, their part as physicians, strictly speaking, ended. Thereafter the base of investigation shifted. No longer was it a question of discovering what made the baby sick, but what caused the milk to turn sour. To settle this point the chemist, bacteriologist and sanitarian, none of whom need necessarily be a physician, although much of their work is still associated in the public mind with holders of a medical degree, were brought in. With their assistance methods of milk production, handling, refrigeration, delivery and sale were evolved; sanitary machinery was suggested, principles of operation were laid down. But this work did not solve the problem. Not only is clean milk necessary, but it must be cheap. Otherwise those who need it most may go unsupplied. Here was a problem for the business man and economist—a problem closely related to transportation and a score of other purely industrial questions. Meanwhile the work of organizing and directing forces of country milk inspection was going on; legislators were endeavoring to secure the necessary appropriations; lawyers were working on milk legislation, while countless other forces were turned loose on the problem, each making its own contribution to the final solution.

All this work has been done merely to rectify certain deleterious conditions in the physical elements of a food product which, like water, gas and many other commodities upon which the health of communities depends, is largely under public control. Much of it has been done by individuals who, in all likelihood, never held a baby in their arms; but has this marred their efficiency? Not a bit. For this is a purely scientific problem, the object of which with them has not been the baby but the milk.

Still all of us know that in the reduction of infant mortality intelligence among those who actually care for the baby is a prime factor. Even the purest milk, if exposed to the dirty air of a tenement, and supplemented by pickles and tea, is not enough to keep a baby alive. Ignorance of simple and fundamental principles of care and hygiene on the mother's part kills many a baby. Physicians again have discovered this and other general hygienic facts for us, but it is left largely to the visiting nurse and the social worker to spread intelligence on such matters in the home. Thus even in what hitherto has been regarded as the physician's exclusive field—the personal oversight of individual babies—other workers have entered to do what he has shown to be necessary. Doctors and social workers alike are beginning to recognize that, while corrective treatment of exist-

ing sickness will remain a factor for a long time to come, emphasis hereafter must be placed more and more on the development of preventive measures. It has become axiomatic to say that it is more important to teach mothers how to keep their babies well than to cure them after they are sick. It takes skill and training to correct a deranged digestion. It takes simple common sense, combined with a knowledge of what constitutes wholesome food and right living, to prescribe a regimen which will make a deranged digestion an impossiblity. Teachers do not need to be scientists. The laws of health, like the laws of astronomy and mathematics, need only to be understood, propagated, and obeyed to secure beneficent results. And because the physician (except where he is directly connected with some organized social effort) has no spare time or energy for social teaching the problem of dealing with the ignorance which he has pointed out as a chief cause of infant mortality, like the problem of improving the purely physical properties of milk, has passed into other hands.

But even when we have taught mothers, and improved the supply of cow's milk, we are still far from the solution of our problem. Why, for example, is cow's milk necessary for the infant? Why does not the mother nurse it herself? These questions, raised by the physician, find an answer in social conditions. Overwork, nervousness, anxiety, too frequent bearing of children, malnourishment, undernourishment, even ignorance itself —these and other conditions which affect not only maternal nursing, but maternal care in every other direction—have their origin in conditions of home and family life. Perhaps it is the father who is out of employment, leaving his wife to become the wage earner at the expense of her infant; perhaps it is a case of preventable illness among one of the older children which has drained the family budget—a thousand circumstances and conditions, which fill the case records of our charitable and philanthropic societies—all exert a direct influence on the mother and babe. Thus we see that infant mortality from being a purely individual problem, is developing into a social problem. Whatever deleteriously affects the home and the family, we see, deleteriouly affects the child, and our *chief* problem, therefore, becomes that of rectifying these deleterious conditions and of discovering the means of their removal.

This is the task of the social agent.

He or she it is who deals not with the baby alone, or with the mother and baby, but with the father, the little brothers and sisters, the grandparents, the aunts, the cousins and the neighbors, each and all of whom, in every act and relation of life, are inextricably bound up to its health and happiness.

But now we are led by our problem far beyond the home for clearly, work which is confined merely to the family group will never rectify those conditions of employment, wages, and the like which find their roots in

social organization on its broadest scale. From the treatment of bodily ailments in individual babies and the passing on of scientific discovery to specialists for special use, we have come to the treatment of society as a whole; to the discovery of the most complex and difficult social relationships; to the education of people by the hundreds of thousands and through myriad channels; to the organization of all forces which exist to promote health and relieve distress.

The physician, through his investigations and experience, has laid the foundations of data and information on which public health is being built up. He has indicated the problem, but others are now needed to work it out in conjunction with him.

In the field of things physical the sanitarian is now a recognized necessity to all health work.

In the field of things social an expert is also vital to the development of all health programs; but this fact is as yet little recognized by physicians and health officers. A very real need exists in our health departments today for social organizers and directors—men and women of special vision, training and experience in social work—who will do for whole communities work of social organization which is already being done by philanthropic leaders in single and smaller fields. All over the world students, scientists and thinkers are discovering for humankind the *immediate* medical, sanitary and hygienic causes of suffering and ill-health. The problem now is to discover the social causes of these other causes and to formulate and direct against them a social program, in which all forces shall take part.

This is the work of the social specialist. He may be a physician, or he may not. A medical degree certainly is not an essential. What he must have is social vision and definite social training—the ability to see things in the large and the experience to put his vision into practical social programs.

Health work, viewed from the standpoint of social prophylaxis is passing from the practicing physician's hands. Hereafter if the physician wishes to play an effective part in our health programs he must make a deliberate choice between three professions:—first, his own special calling, requiring as it does, years of intensive thought, study and experience and concerning itself largely with problems of individual health; second, the profession of the sanitarian which deals with physical elements; and lastly, the profession of the social organizer dealing with social conditions in the aggregate.

The choice between practicing physician and sanitarian already has been made by many men, and a few, recognizing instinctively the need of social organization in health work, have given themselves to it with marked success. In no city as yet, however, has this branch of effort

in health work been pushed nearly to the point where it could be if medical men and health officers, still lacking for the most part in social training, would call upon the social specialist. Among some of them, at least, there is still antagonism to the social worker. The idea that health depends upon social causes has not yet gained its way. Reluctantly will they admit that this most effective kind of preventive health work requires the services of one who may not possess a medical degree.

An illustration of what I mean, and of the social loss that may result has just been furnished by Milwaukee.

In May, 1911, in response to a widespread public demand, the common council of Milwaukee passed a resolution authorizing the mayor to appoint a Child Welfare Commission, the object of which was to study and investigate the causes of infant death, and to formulate and carry out a plan of Child Welfare work from the standpoint of the entire community.

Three leading physicians were appointed to serve on this committee —a professor of pediatrics in a local medical college whose enthusiasm and interest had been responsible for the Certified Milk movement in Wisconsin; an obstetrician—the head of a local maternity hospital which had long played a prominent part in the infant welfare campaign; and a general practitioner, who was known throughout the state for his activity in social movements and who had especially identified himself with efforts to reduce infant mortality. A social worker, who had given five years of special effort to infant mortality and Child Welfare was engaged as executive.

The work of the Commission during the first year was devoted to a comprehensive survey of the local field, embracing such special studies as the cost of an infant's milk; a study of the care of babies in hospitals, institutions and baby farms; a close analysis of the social data contained in 10,000 birth certificates for 1911 and of 1200 death certificates for 1910 and 1911; a study of the relation of the problem of infant mortality from the educational standpoint to the problem of the school and the social center; a study of work to reduce infant mortality at home and abroad; and a special study of methods of work and their cost in restricted local areas specially selected for demonstration purposes.

Basing its conclusions on the knowledge and data gained in this intensive and extensive survey, the Commission at the end of the year formulated what it called a "community plan" for meeting this problem. An ultimate and immediate program of work, based on a unit system of preventive health centers, was laid down, to carry out which it was proposed that the municipality, through its Health Department, should continue and direct the work of social organization, promotion and education which the Commission up to this time had been doing and which it regarded as absolutely essential to the development of Child Welfare work.

This program was not carried out because of the opposition of a physi-

cian, formerly health commissioner of Milwaukee and under the recent change of administration its present mayor. His insistence was that the problem of Child Welfare was largely medical in character and that, as such, only a medical man could properly direct it. Ignoring the recommendations of the Child Welfare Commission (which, I am glad to say, were endorsed by the Milwaukee County Medical Society at a special meeting called for their consideration), he dispensed with their services and reduced the work which they had been doing to a routine function of the Health Department, for the head of which there was secured at an inadequate salary a young man one year out of medical college with neither medical nor sociological experience in this field.

I mention this specific instance because if, as I firmly believe, the trend of medico-social effort in Child Welfare work is towards social organization and promotion, then the lack of understanding and appreciation of this fact illustrated by the opposition to it of a supposed health expert and municipal leader seems to me to point a very serious moral indeed.

Social organization in Child Welfare and Health work is bound to come. The whole trend of effort is in that direction. The rapidity with which public health officials recognize this fact and call upon social workers to assist them in their social programs, as they have already called upon sanitarians to help them in their sanitary programs, will measure the rapidity with which our general health problem, so largely dependent upon social conditions, will be solved.

SOME NOTES ON RECENT TYPHOID FEVER OUTBREAKS IN KONA, HAWAII.

E. S. Goodhue, A.M., M.D.,
The Doctorage—Hawaii.

Read before the Hawaiian Territorial Medical Society.

Shortly after my arrival here in 1904, namely, on the 17th of April, I was called to see a case of typhoid fever at Hookena. The patient, a female Hawaiian child of four years, it was claimed, came up from Honolulu a few days before and had been ill there only a week. There were no further cases at this place, but April 19th, a Japanese male was taken ill at Honokohau some twenty-five miles distant from Hookena. This closed the record for that year.

On April 5th, 1905, I had a very severe type of typhoid fever in a native boy aged 22 years who was employed as a hand on the steamer plying between Hookena and Honolulu. He had been ailing for nearly two weeks with headache, diarrhœa, and slight fever before he made up his mind he was sick enough to go to bed. There was no definite history of exposure except that he had mingled with his kind in Honolulu. No further spread occurred till September 1st when Moana, a native male, aged 22, was taken down. He lived at Hookena beach not over half a mile from Apela, the steamer-hand.

October 15th, Ella Waiala took ill, her home being some three miles above Hookena at an elevation of about 1,300 feet.

Ten cases followed in eight houses at different locations along the Government Road, all within a radius of two or three miles, the epidemic ending December 9th, with a Japanese laborer, aged 23 years. There is no other way of explaining the spread except by contact. As soon as possible each house was thoroughly fumigated and those recovering disinfected, but during the epidemic it was impossible to keep members of the different families from visiting back and forth, and, after convalescence, friends came in to offer congratulations, embrace, kiss, and so on.

One year passed by without any further outbreak, when, on April 26th, 1907, a Portuguese, aged 18 years, came up from Honolulu and went to bed with what proved to be a severe type of typhoid fever.

The next case occurred at Kealakekua, W. Caucasian, male, aged 33, laborer, this being late in October 1908. The real affection was masked by a coincident pneumonia, made more formidable by the fact that the subject was a drunkard; and a late and fatal intestinal hemorrhage was the only

indication that the patient had typhoid fever. There were no abdominal symptoms, and, during most of the illness, there was low temperature with no rise and fall. The patient's sister G. W. nursed him throughout the illness. He died November 22d.

January 13th, the W. baby became ill with what appeared to be a severe bronchitis, but he was treated for typhoid which soon declared itself. None of the other members of the household, three in number, contracted the disease, and G. W. returned to her father's who lived about half a mile distant.

March 27th, Mrs. Mia, at Laaloa, at least ten miles north of the W. house, was taken ill, and two months later died of typhoid toxæmia. During the month of May, same year, there occurred at Kamalumalu, north Kona, about a quarter of a mile from the Mia house, the death of a Portuguese, male, laborer, aet. 24 years.

Taken ill in Honolulu, he came to Kona on the 14th day of his attack, and died at the end of the third week. His death reported to the Japanese doctor as due to typhoid fever, was seen by Dr. Hayashi a few hours before it occurred, the immediate cause being a severe and uncontrollable intestinal hemorrhage.

Upon investigation, I found that the sister of the deceased was ill with typhoid, as well as nine other persons, scattered among six Japanese houses within a radius of quarter of a mile, and not half a block from the infected Simas house.

Theses cases diagnosed as "cold," "grippe," "diarrhœa," were, of course, not reported to me as contagious or infectious.

I found that this Portuguese family was supplying milk to the six infected families, as well as to one or more families nearer by; that the milk, of course, was unboiled and carried in very unclean bottles. These were ordinary quart beer bottles with cork stoppers, and sometimes paper. In fact, the family was notoriously filthy not only as to dress and habits but in their cooking.

The next cases occurred during the months of June in a native house a short distance (third of a mile) from the Simas place, receiving its supply of milk from the latter.

From this source the disease was carried by contact to Kahaluu, a settlement of natives about half a mile distant.

In these two villages 12 families were involved, in one family there being 11 down with the disease at the same time, four of them dying. Despite our efforts, the sick were taken away, some to the beach on horseback, others to other places, until we secured police control of the infected premises. One patient died while being conveyed to the beach on a mule.

While these cases were in hand, a native man at Keokea, 17 miles south, became ill and died of the same disease.

About the middle of June I was called to attend two daughters of R. W. the father of W., living at Kealakekua, as mentioned before. These girls had been taken ill two weeks previously. Upon determining that the disease was typhoid, and learning of the domestic arrangements of the household (there were nine other members of the family), I urged the removal of the well, but this was objected to by the parents and, indeed, there was no place where the infected patients could be properly treated.

One by one the members of the family were stricken down, in the following order:

G. W. (who had nursed her brother) aet. 21 years, female; Alma, aet. 18; Charley, aet. 33; Mollie, aet. 17; Rudolph, aet. 9; W. Sr., aet. 60; Violet, aet. 6; Mrs. W., aet. 42; Vannie, aet. 10; Maggie, aet. 12; Henry, aet. 24.

Ten of them were in bed in the same house at the same time; Henry was taken later when we had established a temporary hospital.

I may mention in this connection that two sons had died a few years previously of typhoid intestinal hemorrhage, and one daughter was "given up" by her physician in San Francisco, suffering from the same disease.

There seemed to be in each case an idiosyncratic liability to bleeding: epistaxis, intestinal hemorrhage, dysmenorrhœa, and hematemesis, and, whether due to glandular alterations of the intestinal mucosa, or to gastric dilatation and attendant conditions (all of which according to Osler and others are said to induce to typhoid), it was under the circumstances impossible to determine.

Early in July a member of A's family next door to W's, was taken ill, and four other members in the house contracted the disease, as well as a niece who was staying with them.

During this month Mrs. K. aet. 36, who nursed the W. family for two weeks, was taken ill and died four weeks later, after a severe and pitiful struggle with persistently high fever, bronchitis, praotitis, nephritis, cystitis, chole-cystitis, pneumonia, peritonitis and final toxæmia.

Towards the last of July a Japanese who had been doing the washing for the A. family, came down with typhoid fever. Then followed cases here and there in the district, two natives some three miles south, a Portuguese ten miles north, and so on.

The season was unusually dry and warm, and the epidemic lasted through July, August, September, October, November and December, cases breaking out in different sections; 4 in Kealakekua 10 miles from W's house; 5 at Kahaluu, 7 miles north, and 3 in a Portuguese house at Kainaliu in September; 6 in Kahuluu, and 2 at Kealakakua, in November.

There were two cases in a Japanese house at Kalahiki 15 miles distant from the original focus, closing the record for 1909.

In July, 1910, Dr. Hayashi reported two cases at the Plantation Camp at Kainaliu, as "para-typhoid," but when I saw them I found them to be

typical cases of typhoid, and had them removed to the hospital. A sporadic case, third week of illness, was found about half a mile from the hospital. The patient, a native woman had been here only a few days, having come from Honolulu to Kona because she was "sick." Two of her children in Honolulu had died before she was taken ill. September 6, a case was reported from a native house one mile from the Simas house, and on the 10th the first of a series of 15 cases among a group of four native houses just above Kainaliu, was taken ill. Nearly every member of each family had fever, and the epidemic lasted till December 26th, when it ended without another fresh infection.

In August, 1911, during my absence at the Coast, typhoid fever broke out at Kawaaloa, a location from three to five miles from Kealakekua. There was some doubt as to where it originated, but it was supposed that a woman who came to Kailua while ill and was taken to Kawaaloa where she died, must have had typhoid fever.

D. S. Bowman, Chief Sanitary Officer of the island with his usual efficiency took the cases in hand.

Unless there were cases not reported to any of the physicians in the district, Kona was free from typhoid fever August 24th, when I left for my vacation. The only disease that might have been mistaken for it by the laity, were two cases of pneumonia at Kealakekua which I saw and treated before leaving.

After my return, on the 25th of November, 1911, I found a case of typhoid fever in the same group of houses where the epidemic of 1910 occurred, and the same boy whom we had discharged from the hospital at that time, was ill. His case had been long and tedious in the first attack, and when we found him in the second he had been ill a month and was in a moribund condition, dying a week afterwards. The day we removed the boy to the Hospital we found at Kealakekua Kele, native 36, ill of the same disease, He had nursed the Kawaaloa patients, and returned to his home.

The last case ending the year 1911 was taken into the Hospital at the close of the year, a woman who contracted the disease from a friend who came to visit her from a neighboring district (Hamakua), and spent his holidays in bed at her house.

EPIDEMIOLOGY.

The course of the original epidemic was easily traced, of course. Next, from Honolulu to the Portuguese house, and from that prolific source, *per viam lactem*, to the six Japanese houses, and the native place close by. Here the frequent visitations with food exchanges, and intimate hospitalities, spread the disease to Kahaluu, from there in the same manner to locations on the beach, Keokea, Kealakakua and Kalahiki. That is, by personal

contact, by food, clothes, drinking cups, accomplished in surreptitious nocturnal visits.

I doubt if police supervision, as we have it here, will check this intercourse to any extent. The only way to stop an epidemic in Kona, is to place all the patients in a hospital under the charge of responsible nurses, and then thoroughly disinfect the infected quarters. This we finally have done with success.

How the two W. girls contracted the disease is harder to determine, as they were Caucasians, and did not associate to any extent with the natives. But one of them had nursed a brother with the disease, leaving the house at his death which occurred November 22nd, and remaining at her father's house thereafter, till she was taken ill June 15th of the next year, that is, nearly seven months after exposure. Contact and want of care, perhaps, in handling cups, glasses, etc., passed the disease from one member of the family to another.

Naturally, in a small house, eleven patients all in bed were not easily cared for although we had two trained nurses as well as several other assistants.

Osler says—"Even in hospitals there is some danger, despite all precautions," and Schrader has estimated that 3.3 per cent of all cases are due to hospital infection." In many cases the disease was contracted by a child in the bed next to a patient with typhoid fever. . . . It is especially liable to occur if the hospital is unduly crowded." Now in the W. house we were "unduly crowded," of course, and so were most of the native houses, especially the one at Kahaluu where 11 persons were ill at the same time, confined to three rooms.

Of course we made use of the verandas, and, in some cases, I placed patients out of doors under provisional covering rather than have them in small ill-ventilated rooms.

The A's who lived next door to the W. house "ran in" to see their cousins; possibly they used their glasses to drink in.

Mrs. K., who nursed the W's was an early victim, but her sister, who also assisted, did not contract the disease.

The infection of the Japanese laundryman is also clear; and while all the subsequent infections may not be traced so clearly, they are easily accounted for by the well known fact that there was more or less intimate intercourse between infected and non-infected families which afterward contracted the disease.

Until the hospital was established we could not prevent this intercourse.

Each season the epidemic began at about the same time, and closed in December. In Kona, as a rule, it is dry from November to February, and the "wet" season comes on after that with variable showers till November

or December again. The 1909 summer was rather dry, the two subsequent ones were wet.

Osler says, "the disease usually persists on into the Winter months, with a decrease after December," and so it certainly has been in Kona, although one should not think the application could be made in a tropical country where there is such a small variation in temperature.

We find in the last report of the Committee on Typhoid fever at our recent meeting of the Association:—"A striking seasonal (summer) prevalence of typhoid fever in a community should not be taken, however, as a positive indication that the disease is due entirely, or even in greater part, to endogenous infection."

Although the three outbreaks of typhoid fever in Kona were classically seasonal, the first was exogenous, as well as the last, while the epidemic of 1910 so far as we can determine was residual or prosodemic.

"In a sudden outbreak," says the report from which I have just quoted,—"in a community previously practically free from the disease, unless there is strong evidence that milk is responsible, water should be assumed to be the cause of the outbreak until proved otherwise." This is logical.

The outbreak of 1909 was caused by milk, but only in a limited radius, outside of this the infection was spread by contact, and in a few sporadic cases, by indirect pollution of either food or water. As is well known locally, all drinking water in Kona is stored in tanks, filled during the rainy season by showers falling on the iron roofs. These tanks are often filthy and hold large deposits of mud and other débris washed into them from the roof and gutters.

In a previous report I suggested that possibly the mynad bird which is a scavenger and a common visitant upon our roofs, might well be a carrier of the bacillus typhosus.

With feet freshly infected from typhoid excreta, it flies to the roof parading in its fashion over it, or carrying paper and other refuse into the gutters from which a new and rapid shower washes the infected material into the tank, where it is kept in the sedimentary portion from which the water is drawn.[1]

According to accredited observations made by reputable bacteriologists, the living germ of typhoid has been discovered in water kept for several months in a sterile condition.

To how much better conditions for preservation does the bacillus come to rest in the sediments of tanks which have not been emptied for years?

In no other way have I been able to account for sporadic cases occurring in widely separated houses, where infection could not have been passed by contact; in regions where the ordinary insect carriers like flies, mos-

[1] Short Report of the Kona Epidemic of 1909, to U. S. Surgeon-General.

quitoes, cockroaches, etc., could not have been factors; where, indeed, the infection seemed water-borne and the probable cause the far-flying mynah.

I called the attention of the plantation authorities on Kauai in 1900 to this possibility of infection where several cases of typhoid occurred in the camps, and could not well be accounted for in any other way. Later observation here have convinced me of the probability of this means of transmission.

Since first making this suggestion I have observed the mynah scratching up fresh fecal matter, then flying off with its feet well covered.

"Surface wells and springs locally polluted," says Dr. Lumsden, "may give rise to few or many cases of the disease among the persons using them," The danger of infection through water supplies has been minimized by the influence of a retro-active pendulum-like swing of opinion which occurs in medicine as in other things, every once in a while; the facts do not justify it.

McCrae whose investigations are careful and conservative, says that water must be regarded as an important means of conveyance, and that "the steady decrease in the disease in communities as the water supply is improved is perhaps one of the best proofs of the importance of water-borne infection."

Shuder reports that in 638 epidemics investigated, infection was carried by water in 71 per cent of cases.

In presenting a summary of the valuable reports on typhoid fever in the U. S. military camps of 1898, Dr. Vaughan says that they "furnish most positive proof that the dissemination of typhoid fever was most largely from persons to persons through contact and not through infected water or food."

The locations selected as to water supply, and the fact that most of the drinking water was boiled, may account for the elimination of water as an important source of infection in those camp epidemics. Later investigations into water supplies and their relation to typhoid fever epidemics in cities like Chicago, Milwaukee, Toronto, Cleveland and smaller towns along the Great Lakes, show unmistakably that the discharge of sewage into the Great Lakes results in severe and frequent outbreaks in typhoid fever in cities and towns which derive their drinking water from those sources.

This was remedied to some extent by extending the intakes far out into the lake, but finally the water was polluted there also.

I mention the matter here because it is evident that if the typhoid germ retains its vitality and infective powers in the Great Lakes where there is extensive dilution of organic matter, and in running streams where such matter would naturally have a tendency to disappear, how much more likely

are we to find abundant sources of infection in our tanks and cisterns made available to the introduction of germ life by so many means.

Cups, glasses and other retainers are dipped into the tanks, to say nothing of other modes of pollution which I have specifically mentioned.

As is known, the bacillus typhosus has been identified in drinking water by the agglutination tests, by Wesbrook in Mississippi water, by Fox in Scranton reservoirs, and by others.

A most interesting isolation of the bacillus in well water was made this summer by Lewis of New Haven. Water from a boxed stone-laid well, about twenty feet deep, located where it was subject to surface wash of the cellar floor, was examined with the following result: "Plates, lactose, bile-agar in duplicate, showed 1,000 odd colonies after 48 hours, the greater proportion microscopically resembling the colon-typhoid group."

Without any apparent cause a maid who had come to the house to open it May 11th, was taken ill with typhoid fever June 19th. She had used this polluted water. And the only explanation of this pollution, so far as could be traced, was that some laborers who had access to cider in the cellar had voided urine on the floor.

"It was quite definite," says Lewis, "that the sample that showed the typhoid bacilli were from the house well, and considering the chemical partial analyses, and the negative colon test, it seemed very reasonable that urine could be the only condition giving rise to the situation." And yet as a mere surmise, how many would have for one moment entertained the idea that infection came about in this "far-fetched" way. Such instances show us how the spread of typhoid fever may be due to the most obscure and indirect contamination; that until we have negative proof, we need not ridicule the man who claims that some germs discharged into Lake Erie have caused an epidemic in Chicago. We simply show our ignorance if we ignore any of the possible channels by which typhoid may be disseminated over the country. It is due largely to this peculiar attitude of the professional mind that we have suffered so extensively.

There were neither facilities nor time for any extended bacteriological examinations or definite laboratory work. While this is to be regretted from a scientific and medical standpoint, I do not know that the findings would have helped us any in the adjustment of conditions or the care of our patients. Besides, this phase is well covered by other observers elsewhere.

Cultures of the typhoid-colon group were secured by Mr. Bowman, some satisfactory Diazo-reactions were made, and the bacillus typhosus was differentiated in some specimens of urine from a patient who developed a purulent cystitis.

In each epidemic the clinical evidences of the disease were so plain that the wayfarer though a neophyte could hardly err, but early in the out-

break of 1910, we had only sporadic cases which were reported by the Japanese doctor as "para-typhoid," "chronic gastritis," "diarrhœa" or "dysentery"—mild cases even after the symptoms developed, and unsuspected at a time when tests for leucocytic changes and lymphoid tissue alterations, would have had some value. Except as a test in presuspected cases, I have not much faith in the value of the reactions. Hultgen in his recent investigations says, "The Widal reaction is less specific than formerly believed. Its late appearance is its chief drawback, and owing to the indefinite onset of the disease all early Widal reactions should be viewed with suspicion."

And the fact that there is no cultural or morphologic difference between the typhoid colon family of bacilli, but only a biochemic one, makes the test of less value as a clinical asset.

The reports of Biron, Rolly, Naegli and Tompkins it seems to me confirm the summary of Hultgen:

"The study of the individual members of the typhoid, para-typhoid-colon group has demonstrated a marked discrepancy between the morbidity and mortality statistics of these affections—a breach in the epidemiology of these water-borne diseases, the generic relation of which was recognized by a layman before clinicians thought of it. The classification of water-borne and food-borne diseases, however, should be based on clinical evidences mainly. The early bacteriologic diagnosis serves essentially to identify the group to which the germ belongs, cultural tests being insufficient and serologic reactions occurring later in the disease.

"In order to diagnosticate a case of typhoid or para-typhoid infection early, we must suspect it earlier, that is, even before clinical evidences have become manifest. In typhoidal affections the preclinical symptoms consist in the bacillemia and the leucocytic changes which, presupposedly, must have existed for some time, perhaps for two or three days, before the onset of any subjective symptoms. The pre-Widal diagnosis of typhoidal diseases should be the rule, not the exception. Para-typhoid affections are seldom recognized in practice."

I believe this to be true, and the atypical forms of typhoid to which Osler called our attention years ago, and which we have seen emphasized in Tompkin's reports, point to the intimate relation between all affections of the gastro-intestinal tract.[1]

We are forced to the conclusion that many of our affections diagnosed as indigestion, gastritis or diarrhœa, are due to the typhoid-colon bacilli, since "neither clinical nor anatomic phenomena justify the strict separation" of the group fevers, and in the report on typhoid fever in the

[1] Feoces in the Tropics, Medical Record, December 29, 1906.—Goodhue.

U. S. military camps of 1898 we find very generally that cases diagnosed as indigestion proved to be typhoid fever. For instance, in 190 cases of indigestion, 24 proved to be typhoid infection. The same thing occurred in disturbances diagnosed as "febricula," malarial fever, diarrhœa and dysentery.

"These cases show that the so-called 'indigestion' were frequently a prelude—more rarely a sequel, as in case No. 2—to typhoid fever," continues the report.

Bigelow, of Worcester, Mass., calls attention to the value of the Widal reaction in detecting typhoid germ carriers. "The agglutination reaction," he says, "seems of much value in tracing the source of milk-borne epidemics of typhoid fever, where in one case it was most instrumental in bringing a 'carrier' to light."

At one source of infection the dairyman had been producing milk for 30 years. Twenty-six years previously he had had typhoid fever, and again, a few weeks before the outbreak traced to his milk, he had had a slight attack of diarrhœa with some headache, and a slight amount of bright blood in his stools. In his case the Widal reaction was positive. Another case, a farmer, whose milk started a local epidemic of typhoid fever, was found to have had two or three weeks previously an attack of so-called 'grippe' of about two weeks duration, accompanied by 'cholera morbus.' "

Widal reaction positive.

And so on with a large number of these cases of mild attacks. In some of them the excreta and urine showed bacilli of the typhoidal group.

In one case at least of my series, that of a boy of 9 years who had a severe attack of typhoid fever August 1910, and who died of the disease a month ago after an interval of good health, we were obliged to attribute the second attack to auto-infection, as the house had been thoroughly fumigated, and a large family of children lived in it since last year's epidemic.

Evidently the boy carried the germs and in some period of susceptibility infected himself.

What is to be done to prevent such persons from spreading the disease? Manifestly it is impossible as well as impracticable to apply all the laboratory tests and reactions to all patients recovering from typhoid fever; and in no other way can we determine who is a carrier nor, upon determining what patient is a carrier, would it be possible to isolate and deprive him of his liberty or a modicum of it, for a period of possibly twenty-six years!

Moreover, in mild cases of "indigestion," diarrhœa, mucous-gastritis, dysentery, febricula, grippe, or walking typhoid, the most of which I

believe, are due to some of the typhoid-colon group, how can we adequately diagnose and segregate them?

How can we prevent them from spreading the disease among those who may develop it in its typical form?

As a rough and ready test perhaps quite as dependable as the nitric acid test for albumen, Russo's typhoid test recently used at the Toronto General Hospital, is available in general practice.

The house or "typhoid" fly, as it is now called, has been shown to be a prolific cause of the spread of typhoid fever, by depositing on food or food containers infected material which clings to its body, or by the deposit later of bacilli which have been swallowed and carried about for several days. According to Fischer and others, the bacillus typhosus will live in the body of the fly for twenty-three days or more, and outside on the legs for four or five days.

Like the mynah, the fly delights in human excreta and, like him, in frequenting human habitation, but the fly alone has direct access to food and water which may thus be polluted.

In Kona there are few flies, so few indeed, that as a factor in the spread of typhoid fever, they practically may be excluded.

In August, September, and possibly later in some years, a few flies are to be found about the premises, particularly in the vicinity of horse stables. Near the W. house there was a large stable which at the beginning might have been a breeding place for the fly, but the menace was soon removed. At no time were there more than a dozen flies about the house.

In the W. house where we were cramped for room and without conveniences, the cockroach was our principal dread, and no doubt had a great deal to do in disseminating infective material.

Dust as a factor in Kona may be eliminated and so with soil contamination. Our porous rock is not conducive to germ pollution or perpetuation.

While we did not tabulate any data regarding the occurrence of intestinal worms (the whip-worm—*trichuris trichiura*, and roundworm—*ascaris lumbricoides*) in typhoid patients, my attention was called to the fact that in ten of our cases we had one or both of these parasites present, in one instance, that of M. W. several of the ascaris were vomited.

In regard to the virulence of typhoid in the tropics, Manson says: "It would appear that not only is typhoid a common disease in the tropics, but that it is also very virulent, with a death rate twice as heavy as the death rate of typhoid in England. According to my experience in China not only is the tropical form grave from the outset, but it is extremely liable to relapse. Besides exhibiting increased virulence, experience has shown that as against typhoid those sanitary safeguards which are found to be practically sufficient in England are by no means so effective in India."

There is neither time nor space to enlarge upon the methods of treatment we followed. Tub baths we were unable to give in any but the last outbreak, but sponging was carried out early, and all the hygienic measures which experience has indicated for such conditions. I used acetezone because with it larger quantities of water were consumed. Most patients take too little water, and the regular requirement of so much solution ensures it to them.

Meeting symptoms as they arise or, better, anticipating them if possible; the palliative method is about all that can be done. I know of no disease in which brains are more necessary in the attendants than in typhoid fever.

A little acetanelid occasionally when indicated; a little opium, preferably the powder, to quiet extreme nervous manifestations, a conservative use of whatever seems indicated for a particular condition; a sane and sensible vigilance throughout; these are the best therapeutic measures known to me.

I will only say that in my hands cold tub baths have not given me the results expected, but on the other hand, in many cases, they have proved highly detrimental and, in some high temperatures such as we get in jaundiced types here, I consider cold baths unsafe. I have substituted what in my opinion will prove to be of real benefit in the treatment of typhoid fever with high temperatures and severe nervous or toxemic symptoms, namely, *hot* baths, not warm ones.

Generally speaking, I do not believe that typhoid fever is more virulent in the tropics than elsewhere under the same conditions. Indeed, I believe it is less so. The same class of patients in a temperate climate, filthy, ignorant, careless, indifferent, surrounded by unhygienic and insanitary conditions, would give even a higher mortality than is recorded in the tropics.

Indeed, under right conditions, I have noticed quite a modification in most of the cases of typhoid fever in California and here, in the direction of amelioration, just as we find that in scarlet fever, this climate with its even temperature, cool nights, constant circulation of pure air and well-ventilated dwellings, conduces to a mild type of disease. The cold of a severe climate limits one's hygienic resources, and its sultry heat not found in Hawaii at least, has a depressing effect on the typhoid patient.

It would not be fair to base any deductions upon a series of cases of typhoid fever prevalent in native houses and running an uncared for course there. Here we had small, closed-up rooms with no air even from a window. Patients lay abed in their day clothes, unwashed during the course of the disease, sitting up with a temperature of 104° F., and eating any kind of food, paying no attention to the condition of the bowels which

were often constipated for days at a time, or perhaps getting up and walking in the sun, or even taking a horse-back ride to the beach.

How many Caucasians with an ordinary attack of typhoid fever would endure such a course of treatment as this?

Under these conditions, in a series of 150 cases, the mortality was about 20 per cent; in the same number under hospital care our mortality did not exceed 8 per cent.

REPORT OF THE COMMITTEE ON COLD STORAGE.

Read before the American Public Health Association, Washington, D. C. September, 1912.

To the Members of the American Public Health Association:

The Committee on Cold Storage in making this, its first report, wishes to make it clear at the outset that this is only a progress report and by no means the final word on the subject. It asks the indulgence of the Association if vital matters pertaining to cold storage are not here discussed, as we have had only two months in which to collect our data and prepare this report.

Considering the dominating importance of the conservation of foods by cold storage and with a view to conducting it as a business along lines conducive both to health and commerical advantage, it is desirable that some official authority be constituted by Federal or State enactment in order that the results of scientific experiments and practical experience may bring about the establishment of uniform regulations applicable to the condition and preparation of the different foods intended for cold storage, to the temperatures and periods of time during which each is to be maintained in cold storage and to the conditions under which different foods are to be removed from cold storage or dealt with after transference therefrom.

The report of the Massachusetts Commission to investigate the subject of the cold storage of food and of food products kept in cold storage very ably summarizes the purposes and value of cold storage in the following words:

"In general, the Commission recognizes that cold storage is a fundamental necessity in the distribution of the food supply of the nation. In the first place, it enables perishable food products to be brought to market with the least possible deterioration; in the second place, it enables the surplus of such products in the season of natural plenty to be carried over to meet the demand in the season of natural scarcity. The latter is the principal economic function of cold storage. It acts as a means of distributing the seasonal output of perishable food stuffs evenly over the market year, thus helping to equalize supply and demand."

Speaking of the influence on health the same report continues:

"While abuses have arisen through the holding of food products in cold storage for unduly long periods and through the handling of goods by improper methods before and after, as well as during, refrigeration, the benefits that have come from the salvage of food through cold storage far outweigh any evils that have developed in this field. Cold storage has brought about an expansion and diversification of the food supply of the

population, making certain kinds of food more abundant and more accessible. It thus makes for the conservation of the vital resources of the people. The gain from this source is universal and permanent, the injuries are occasional and temporary, and can be eliminated by proper regulation."

In considering the question of regulation or legislation on this subject the committee believes the following suggestions should be carefully borne in mind.

1st. "Cold Storage" should be deemed to apply to any process for maintaining food for human consumption at such temperatures as will maintain it in its highest state of wholesomeness.

2d. The term "cold storage building" or "warehouse" should be deemed to apply to an establishment employing refrigerating machinery or ice for the purpose of refrigeration, or a room or building otherwise artificially cooled.

3d. The term "article of food" as used in cold storage regulations should be interpreted to include all articles of food, animal or vegetable, for human consumption, requiring any regulation of temperatures for their efficient sanitary preservation.

4th. No article of food should be placed in cold storage which is not mature, fresh, free from disease or deterioration of any kind.

5th. It is essential that all foods possessing a temperature favoring some degree of deterioration should be cooled to a proper temperature as rapidly as possible with a view to maintaining it in its natural condition of freshness.

6th. After placing in cold storage it is essential to successful storage that the temperature and humidity found best for each particular food be maintained as evenly as possible.

7th. It is further essential that with certain types of food products circulation of air be maintained in the cold storage warehouse, and that an adequate amount of fresh cooled air be introduced each twenty-four hours; or, that the circulating air be passed through some solution depriving it of the volatile emanations of the food.

8th. Every storage warehouse should be constructed of such materials as will not cause organic emanations and in such a manner as will facilitate maintenance in as good sanitary condition as is maintained in the most modern plant employing the most modern methods for the preparation and handling of perishable food products.

9th. The periods of time during which food products should be allowed to remain in cold storage should depend upon their original freshness of condition, the continued maintenance of their optimum cold storage conditions and on the results of further investigations on each class of food products.

10th. It is desirable that frozen cold storage food products be raised

gradually to higher temperatures varying according to the size and nature of the article of food in order to preserve the tissues in their natural condition.

11th. Articles of food should not be returned to cold storage which have once been released and raised to materially higher temperatures. When it becomes necessary to transfer food products from one cold storage warehouse to another the temperature should not be allowed to rise to a point favoring deterioration.

12th. In order both to maintain cold stored foods in the best condition possible and to preserve the credit of cold storage methods it is essential that municipal control of foods placed in retail stores for consumption be of the most practical and scientific character.

The committee has endeavored to ascertain what laws and regulations have been passed and are now in force in the various countries represented in this Association. There are six states in the United States that have legislated on the subject of cold storage. Congress has had under consideration a bill on this subject which, however, has not been enacted into law. Various unofficial bodies have studied the subject of cold storage and proposed legislation to regulate it,—notably the Chicago Association of Commerce and the American Association of Food, Dairy and Drug Officials. Canada has a law designed to encourage the cold storage of foods, but none of its provinces have legislated on the subject. Notable work has been done by the Massachusetts Committee to whose report reference has already been made. The committee gratefully acknowledges the assistance given by various branches of the United States Government departments, and the generous offers of assistance extended by the Association of Refrigerating Engineers and the Cold Storage Warehousemen's Association.

In offering this report the Committee recommends to the Association that the investigations which it has started be continued either through the reappointment of this committee or the appointment of another committee and that the succeeding committee be authorized to coöperate with committees of other associations, either at present appointed or to be appointed to investigate the same important subject.

Respectfully submitted,

Dr. Ward L. Beebe.
Dr. Peter H. Bryce.
Dr. Hiram Byrd.
Dr. W. F. Snow.
F. D. Bell, *Chairman.*

BOOK REVIEWS

PELLAGRA: History, Distribution, Diagnosis, Prognosis, Etiology, Treatment. *By Stewart R. Roberts, S. M., M. D., Associate Professor of the Principles and Practice of Medicine at the College of Physicians and Surgeons, Atlanta, Ga.; Physician to the Wesley Memorial Hospital; Formerly Professor of Biology in Emory College. Octavo, cloth, illustrated. pp. i.,+272. C. V. Mosby Company, St. Louis, 1912. Price $2.50.*

This is the third monograph on pellagra which has been published in the United States, and shows the growing interest in this subject. In his preface the author states that his book is intended for the student and the practising physician; that it is not an academic discussion of the subject; and he disclaims any intention of upholding any special theory of etiology. He also very truly adds: "There has been entirely too much speculation on Pellagra, and entirely too little investigation of Pellagra."

To a great extent the author holds to his promise; and, with some exceptions, later noted, he has presented his subject in a pleasing and forceful manner. His method is at times, perhaps, a little too dogmatic for a subject which presents so many uncertainties. And in spite of his statement that there is too much speculation he has allowed himself to speculate somewhat on the question of etiology. He has, however, greatly compensated for this by his sane views on other phases of the disease.

He has given a good résumé of the history and geographical distribution of pellagra. In his discussion of the clinical side of the disease he has departed from customary methods of classification and devised a rather elaborate classification of his own, which is of doubtful utility since it seems to have added neither to the clearness nor the simplicity of an already difficult subject. Outside of this rather awkward classification, however, he has given an good clinical description of the malady.

There are other places in the book where the author displays this same desire to strike out into new paths of classification or terminology, and very rarely with any satisfactory result—for example, his very questionable change of "pellagra sine pellagra" to "pellagra sine exanthemata" (*sic*); and his substitution of dermatitis and "dermotagra" for the usual term erythema, which by most dermatologists is recognized as the proper classification of the skin manifestations of this disease.

His remarks on diagnosis and prognosis are sound, and his discussion of treatment is commendable with the striking exception that he seems to think rest a factor of very minor importance—an opinion directly at variance with that of other men of wide experience in the United States where the disease presents features quite dissimilar from the Italian pellagra of today.

His ideas on etiology are very decidedly tinctured by the hypothesis of Sambon; and he adopts as likely the view that the disease is of an infectious nature, the casual agent being insect-borne. His discussion of etiology is consequently somewhat lacking the judicial tone which should have characterized it.

There are several errors in the book which should not have escaped the blue pencil. For example, "mal del higado" is translated "disease of madness," and "mal de saintes mains" becomes, rather ridiculously, "the sickness of the main saints." Many of the plates are so poor that they should have been excluded. The presswork is good, however, and the book attractive in appearance.

Aside from these not overimportant deficiencies, the book is a very good presentation of the subject and may be recommended to those interested in this disease, which annually has become of greater importance to the American practitioner.

C. H. Lavinder.

PUBLIC HEALTH NOTES.

Boot Workers and Phthisis.

"Having noticed the number of cases of phthisis which occur in Norwich among boot workers—and, of these, clickers in particular—Dr. H. Cooper Pattin, M. O. H., has been making an inspection (not yet concluded) of the clicking rooms at the various factories. He finds generally not so much inadequate means of ventilation as insufficient use of the means provided, comparatively high temperature and relatively overbreathed atmosphere being by no means uncommon. He found in some cases sweeping up of floors, etc., being done at unsuitable times, *e.g.*, just before work is started and concluded; and upon making representations to the managers found in every instance a ready response to his suggestion that the floors should be damped, and this sweeping up, etc., concluded whilst the workrooms are empty, and at least one quarter of an hour before the work-people are re-admitted. Doctor Pattin drew up and issued a short summary of recommendations *re* ventilation, etc., to be put up in the workrooms. Much dust appeared to collect upon stock patterns, and this must be disturbed when these are used. Two factors, apart from others, have a bearing upon the relative incidence of phthisis among clickers as compared with other boot operatives—one is the bad mechanical position taken up at work. The clickers stand and lean over their work-table, the position of the arms, etc., cramping the chest, and making its full expansion practically an impossibility. Another factor is the circumstance that clicking is regarded as the lightest type of bootwork, and consequently the less robust gravitate to it. 'From these two factors,' writes Doctor Pattin, 'one would expect, apart from all other considerations, a heightened liability to chest troubles. By clickers, it seems to me to be specially important that exercises and gymnastics calculated freely to expand the chest should regularly be taken, and fresh, unbreathed air secured in their workrooms.'"—*The Medical Officer*, September 7, 1912.

"Darkest Cincinnati."

The Cincinnati Anti-Tuberculosis League is making a campaign for better housing conditions in Cincinnati by using motion pictures. Believing that the high death-rate from tuberculosis in Cincinnati is largely due to bad living conditions, an effort is being made to create a sentiment among the people that will compel the correction of these conditions.

A special appeal to the people of Cincinnati is being made through the medium of a motion picture film entitled "Darkest Cincinnati." This motion picture is contained in a reel of 1,155 feet of film, carrying forty-two scenes, and requires twenty-two minutes to exhibit.

On October 10 this film had been exhibited for two days in various theaters with a success that surpassed the most sanguine expectations of the officers of the League. The attendance for the ten days was over 21,500. Based upon the statements of the theater owners, this is about three times the usual attendance of these theaters. The picture was shown in some theaters having as low seating capacity as 250, where it was necessary, in order to handle the crowds in front of the theaters, to display at times the picture in successive exhibits, cutting out all the other parts of the regular program. The theaters have been supplied liberally with literature to distribute to their patrons. The theaters have also been supplied with streamers and single sheet posters, one a "tomorrow" poster and one a "today." Besides this, the theater owners have announced the coming of the film to the audience several days in advance, with a slide. The newspapers likewise have been liberally announcing the itinerary in advance.

More than 15,000 copies of the report of the recent survey made by the League were distributed at the theater doors. It was planned at first to carry on the special cam-

paign only for one month to November 1, but applications from theaters have been received well beyond this date and it may be necessary to extend the campaign.

The film was taken by a Cincinnati firm under the careful supervision of the Anti-Tuberculosis League, which paid for the entire cost of production. It shows typical scenes in panorama and in other ways of various sections of Cincinnati, especially those where housing conditions are bad. Individual houses and selected groups of individuals are also shown. Under each title there is a carefully prepared aphorism driving home the moral of the picture. The picture closes with a description of the work of the Health Department and the League, showing the dispensary, visiting nurses, day camp, a city sanatorium, etc.

Nursing at a Half Million a Year.

Beginning with 751 visits in June, 1909, the visiting nurse service provided by the Metropolitan Life Insurance Company for the benefit of the policyholders has been extended, until in June, 1912, over 76,500 visits were made. For three years the company has been providing this free nursing service in the belief that continued effort of this character will reduce the death-rate among its 10,000,000 industrial policyholders, and thus eventually return to the stockholders the hundreds of thousands of dollars invested in this manner. The number of patients visited, including duplicates, in the three years ending July 1, 1912, approximates 185,000. The number of visits made by nurses to patients amounts to over 1,500,000. These visits cost the company between forty and fifty cents each. A recent report on this subject estimates the cost for the present fiscal year at fully $500,000. While it is too soon to give any definite statistics on the decline of the death-rate, comparisons of the mortality rates of tuberculosis and some other diseases show an improvement to an appreciable degree.

The French Birthrate.

"The Paris correspondent of the *Times* states that the serious decline on the French birth-rate, which last year showed a falling off of 32,869 births as compared with 1910, has led the Minister of Finance to appoint a Commission for the purpose of investigating the causes of the decline and of suggesting remedies. In emphasizing the importance of immediate action if France is to maintain her position in the world, M. Jacques Bertillon, the eminent statistician, points out that whereas a century ago, 27 per cent. of the population of the great European powers were French, today the proportion is only 11 per cent. Formerly French was the most widely spoken language; today it is the mother tongue of only 45,000,000 as compared with 100,000,000 who speak German, and 130,000,000 who speak English. As for remedies, M. Bertillon insists that Frenchmen must be taught to regard a child as a burden which its father supports for the benefit of the whole community. But in order that a family should pay what it owes to the State it should consist of at least three children—two to fill the places of the parents when they die, the third to fill the gaps caused by those who die before attaining adult age. In order to promote this end M. Bertillon proposes a reduction of taxation upon fathers of three or more than three children, in proportion to the number of living offspring—a system already adopted in Prussia, Saxony Servia, Norway, Sweden, and parts of Switzerland. The laws of succession should be modified and formalities of marriage simplified. Mothers of large families should be assisted in various ways, and especial provision should be made for widows left with children. Finally, M. Bertillon suggests that among the humbler class of public servants those candidates for employment by the State who have children should be considered as eligible in proportion to the size of their families."—*The Medical Officer*, September 7, 1912.

Bubonic Plague.

Clinical Medicine for October, in its news notes, considers the almost pandemic character of bubonic plague. It is now present in a number of places in South America, while the latest places to be attacked were

Porto Rico and Cuba. It was thought that rats infected with plague had been discovered in New Orleans, but the United States Public Health Service was unable to verify these supposed findings. Significant as is the presence of plague so near our doors, it will become a much greater menace when the Canal is opened and the West coast of South America is brought into direct communication with our large Eastern ports. Such a prospect justifies the greatest supervision and the most aggressive measures of eradication.

Tuberculin Test in Cincinnati.

The following resolution has recently been adopted by the Cincinnati Board of Health for the protection of the public against tuberculosis from milk and for the conservation of food-producing animals:

Be it resolved, by the Board of Health of the city of Cincinnati, That the following regulations are necessary for the public health, and the prevention and restriction of diseases in the city of Cincinnati, and the same be and are hereby adopted as follows:

Sect. 1. It shall be unlawful for any person, firm or corporation to sell, offer to sell, or have in his possession for the purpose of selling or giving to any person, or persons, in the city of Cincinnati, county of Hamilton, state of Ohio, milk or cream which has not been pasteurized as hereinafter required.

Sect. 2. Milk and cream shall be deemed pasteurized within the meaning of this regulation if the same shall have been heated to a temperature of not less than one hundred and forty (140) degrees Fahrenheit, and held at that temperature for not less than thirty minutes. The health officer of the Board of Health or his assistants shall be empowered to inspect the process of pasteurization, and the premises, apparatus and conditions under which same is done. The pasteurization of milk or cream otherwise than according to the methods and processes approved by the city health officer shall not be deemed a compliance within the provisions of this regulation.

Sect. 3. The above described pasteurization shall be required in all cases except where such milk and cream is obtained from dairies in which all the animals have been proved free from tuberculosis by the tuberculin test and physical examination, and have been branded and the tuberculous animals removed as hereinafter provided.

Sect. 4. That all tuberculin testing be done under the direct supervision of the Board of Health and that same be performed only by a recognized veterinarian or state or federal authorities; all test sheets to be forwarded immediately to the health officer of the city of Cincinnati for approval.

Sect. 5. Tested cattled to be branded by a burnt brand on the hoof or a tattoo on the inner surface of the ear or a self-retaining button in the ear.

Sect. 6. All animals proved to be tuberculous by the tuberculin test to be immediately removed from the herd and the premises properly disinfected and no cattle are to be added to the herd until they have passed a satisfactory tuberculin test.

Sect. 7. No milk or its by-products of any cow showing clinical symptoms of tuberculosis or other communicable diseases shall be sold as human food in any form in the city of Cincinnati.

Sect. 8. This regulation shall take effect and be in force from and after the earliest period allowed by law.

The Dangerous Typhoid Carrier.

"A typhoid fever carrier has been discovered in Moorestown, N. J., engaged as the manager of an important dairy farm. There was an epidemic with a record to date of thirty-two cases and one death. Investigation showed that every case was on the milk route supplied from the farm in question. This dairy was one of the best in the state, according to the inspectors' reports, and there were no records of typhoid fever at or about it. Finally a blood test was made of each man on the place, which showed that the manager had the disease. The strangest thing about the whole matter is the fact that the man did not know he was ill. He did not feel quite up to the mark on one or two days, but he did not stop work although

his system was giving off the germs of the disease which caused sickness in the town and even led to the critical illness of two of his children. The case is a particularly interesting one since it shows the value of the blood test in running down the cause of an epidemic of this nature. Furthermore it shows the desirability of making an occasional test of the employees of dairies in order to be certain that no typhoid is carried by them. This may seem like an excess of caution, yet the danger from typhoid carriers is by no means fully understood and health officers are becoming more and more strict in cases where epidemic may be caused by such persons. Only recently, in fact, the health officer of a large city insisted upon a blood test of all employees of a contractor engaged on work on a dam across a river, at a site where there was some chance of contamination of the municipal water supply. It was felt that in this case sanitary precautions about the camps were inadequate and that blood tests should be made in order to become certain that no danger existed."

Engineering Record, Vol. 66, No. 7.

Air Pollution by Coal Smoke.

The measurement of the amount of coal smoke pollution of the air about English industrial cities and its effects as described by Arthur G. Ruston, Leeds, furnishes a good example of heavy pollution by smoke. In the industrial part of the city 1,900 lbs. of solid impurities are deposited annually per acre. This amount decreases with increased distance from the city, although even at seven miles there are deposited 46 lbs of impurities annually. By a method described in a preceding paper of the same author, the amount of light shut off by smoke at Hunslet, Eng., is found to be 40 per cent. of the total. It is easily seen that this would greatly hinder the growth of vegetation in that vicinity. The direct effect of the smoke on plants is the coating of the leaves with the tarry material in soot and the action of the mineral acids also present. The effect upon the yield of certain crops was tried experimentally at Hunslet and was found that only one half the crops of radishes and one fourth the crop of lettuces was obtained that should be secured in purer atmospheric conditions.

Journal of the Royal Sanitary Institute, October, 1912.

Individual Freedom.

The belated and largely vicious argument of "personal freedom" often advanced as a reason against the establishment of a National Health Department, is interestingly illuminated in an editorial in *Good Health* for September, in the following manner:

"Dr. Eugene L. Fisk, medical director of The Postal Life Insurance Company of New York, is an enthusiastic advocate of a National Department of Health. In an address sent to the policyholders of the company, Doctor Fisk says, 'Many oversensitive people are disturbed lest there may be interference by a National Department of Health with their freedom to injure themselves and their neighbors by unhygienic practices. The fact that the typhoid bacillus is free to pursue life, liberty and happiness in the Peyer's patches of 300,000 American citizens annually, disturbs them not. The American stomach has already been restricted in its freedom to receive poisoned food and the $143,000,000 worth of patent remedies and druggists' preparations that are annually prepared for its delectation, and further restriction is viewed with alarm.' "

The Moving Picture and Public Health.

The difficulty in obtaining approximately complete and reliable vital statistics and the importance of these statistics in their relationship to public health have led the Chicago Board of Health to adopt an educational measure which it is hoped will be as effective as it is dramatic. By an arrangement with one of the film companies the Department of Health contemplates, during the coming year, the presentation to the people, by means of moving pictures, of a play which shall emphasize the necessity of birth registration and which shall present, in this popularly impressive way, the mis-

fortune which may befall an individual whose birth has not been registered.

According to the *New York Times* for October 27 the play itself presents the scene of a household in which the husband is presented with a son and heir and a fancy bull pup upon the same day. Through carelessness the boy's birth certificate is lost while the certificate for the dog is carefully registered. Later, when the boy's legacy is about to be lost owing to the failure of registration, the day is saved by the discovery that the father, in his exuberancy over the birth of his heir had written across the face of the certificate of the dog: "Became father of a fine bouncing boy on this date also." This seems to satisfy the court, and the play ends by a bit of as equally impressive positive teaching, in which the announcement of a son and heir causes the father and grandfather to fall over each other in their haste to get to the Department of Health in order to register the birth of the new arrival. Such demonstrative instruction of the public should do much in improving our very imperfect birth registration.

Fish as Carriers of Cholera Bacillus.

"Max Pettenkofer, the well-known hygienist of Munich, made the observation, years ago, that ground water played an important rôle in infectious disease; upon rising of the ground water the virulence of the disease decreased, while a fall of the water carried with it an increase. The rise of the ground water is preceded by a turbidness of the river system, when the bed of the river acts as a filter; by the fall of the ground water the river bed becomes a poor filter and the microbic organism can more easily enter the ground water. This theory enlisted as many friends as enemies, and well known is the controversy between Pettenkofer and Koch, who, in 1884, discovered the comma bacillus. Among these infectious diseases cholera is included. Drinking water, milk, fresh, uncooked vegetables, and raw fruits are considered the most common carriers of the virus, and India is taken to be the place where the disease originates; it is there endemic.

"All these facts are well known, but interesting, although not entirely new, is a theory which was promulgated for the first time about twelve years ago in Batavia, by a Swiss physician, C. O. Gelpke, who for thirty-two years served as a surgeon in the Dutch East Indies. Doctor Gelpke has returned to his home country, where he now practises, and has written a short essay upon his theory, which appears in the *Correspondenz-Blatt fur Schweizer-Aerzte* for July 20, 1912. He believes that fish are great carriers of cholera and that through fish and their spawn the virus is carried from the source of the river to its mouth. He does not think that man himself and his fomites or feces play an important rôle in the migration of cholera. To diminish the danger of an epidemic, cities have now been supplied with pure drinking water and good filter stations; the drinking water is not taken from rivers flowing past cities, but from wells or rivers whose systems have been isolated. His theory is that the bacillus enters the soil, is carried to the ground water, and thence to the river, where fish and spawn receive and carry it along the current of the river. He has not been able to prove his theory bacteriologically."

New York Medical Journal, August 31, 1912.

Eugenics.

The *Survey* for September 21, 1912, presents an analysis and criticism of the first International Eugenics Congress, held in London in September. According to the *Survey* the chief characteristics of this Congress were the wide divergencies of opinion and the lack of uniformity of program. The conclusion must be reached that Eugenics is not yet a science for "the Congress was more an exchange of views and mutual instruction than a scientific body equipped to work out a platform of concerted action, with the ultimate object of proposing legislation."

However, many valuable contributions were made to the subject by men interested in this phase of biological and social effort. There were discussed the problems of physical heredity, the question of marriage restriction, the effect of militarism on the race,

etc. Such authorities as Peter Kropotkin, A. J. Balfour, S. G. Smith of the University of Minnesota, and others enriched the congress by taking part in the discussions.

Consumptives and the Southwest.

The September *Bulletin* of the Massachusetts State Board of Health presents a letter from Gov. O. B. Colquitt of Texas, to which the Southwestern Conference on Tuberculosis is attempting to give as wide publication as is possible. The letter contains resolutions adopted by that Conference in April, 1912, informing consumptives of the already overtaxed condition of state and charitable agencies in the Southwest and advises invalids coming to the Southwest to have funds sufficient to carry them through at least one year. It announces the absence of public funds and free hospitals, the limited facilities for non-strenuous employment, the exhausted patience of private individuals who might otherwise give assistance, and further asks that physicians, churches, lodges, labor unions, charitable organizations, and railroads become cognizant of the facts before urging or aiding the migration of invalids to this section.

Maternity Insurance.

The *Survey* for October 19 states that the new Italian Maternity Insurance Law has greatly reduced infant mortality among industrial workers. The law provides that all women in industries between fifteen and fifty years of age must belong to a maternity insurance fund, the contributors being the employers and the employees. Mother and child are cared for at least one month after the birth of the infant, and factory owners are compelled to provide a decent room in which mothers can attend to their babies and nurse them. Many large factories have attached a day nursery with a nurse in charge.

Sex Hygiene.

At the annual meeting of the American Federation for Sex Hygiene, held in Atlantic City, June 3, 1912, Dr. William F. Snow, secretary of the California State Board of Health, in an address entitled "Weighing the Evidence" summarized very effectively the conflicting views held by persons interested in the sex hygiene movement in the following way:—

1. Those who believe in educational measures and the establishing of moral standards.

2. Those who lay special emphasis on the administrative control of prostitution, either by segregation or non-segregation methods.

3. Those who adhere to temperance and church affiliation as ultimate solution.

4. Those relying on marriage restriction and eugenics.

5. Those reactionaries who believe that the lesser evil is to leave the problem alone, fearing that all effort will but arouse morbid curiosity.

He further outlined what he considered to be scientifically and morally sound activity on the part of a health department in this field:—

1. Declare syphilis and gonococcus infections communicable and dangerous diseases.

2. Make all cases reportable by physicians or laymen.

3. Publish all trustworthy information about the prevalence and spread of these diseases.

4. Isolation and supervision as far as public sentiment will allow, of all cases.

He said that the state of California in its attempt to carry out these measures, was meeting with a fair degree of success.

The Failure of Model Tenements.

An article in the *New York Times* for October 27 by Mr. Henry Atterbury Smith, architect for the Vanderbilt tenements at 78th St. and Avenue A, and member of the Tenement Economies Society, presents the causes for the failure of the so-called model tenement, as at present constructed and managed, to solve the problems for which they were designed. Mr. Smith also discusses measures which he considers necessary of fulfillment if this attempt to ameliorate housing conditions is to be a success.

One of the factors in the failure of this

form of philanthropy which Mr. Smith points out is the fact that unnecessary expense and luxury are involved in the construction of the buildings, resulting in rents which the people for whom they were constructed are unable to pay. Owing to the increased value of the land in the immediate vicinity of the model tenement, rents are raised in the neighborhood, and thus in an indirect way a hardship falls upon those people for whose benefit the tenement was designed.

Mr. Smith further points out that the present tenement house law, though admirably administered, is too strict in many of its requirements. Its insistance on at least seven feet in the width of the rooms, its demand for space for vent-shafts, which the open-stair tenement has made unnecessary, and the amendment requiring that bath rooms be placed on the street front or outer yard are examples of uneconomical and unintelligent legislation. He suggests that the administration of the law be taken from the hands of the private organization which now has it in charge, namely, the Tenement House Committee of the Charity Organization Society, of which he is a member, and be given to a board, public in character, and made up of charity workers, architects, builders, physicians, real estate brokers, and insurance men. This board could more carefully weigh the conditions and the legal requirements and more rationally and effectively provide for the man who cannot pay more than $10 a month for rent and who is now compelled to live with his family in the filth and darkness of the old houses.

Infant Mortality in Canada.

The Medical Officer for July 27, 1912, presents an abstract of the report of Dr. Helen MacMurchy on infant mortality in the Province of Ontario. The investigator finds that a most deplorable condition of birth registration exists in this province, the registration not being over 75 per cent. of the total births, while as many as 20 out of 636 births in Toronto were registered twice. The causes given are the lack of training of the inhabitants in the necessity for registration, the fact that the registrar receives only twenty cents for each registration, the non-compensatory notification by the doctors, and the absence of prosecutions in default of registration. The infant mortality rate in 1907 was 120 per 1,000 births in Ontario, and 148 per 1,000 in Toronto.

Besides the remedy of the above causative factors, Doctor MacMurchy recommends the payment of mothers by the Provincial Government for the nursing of their children and the establishment of a bureau of infant care under the Board of Health.

English Isolation Hospitals.

The conditions of hospitals for infectious diseases in England is the subject of a report by Dr. H. Franklin Parsons, till last year a member of the local government board, a report so well esteemed in his own country that it is selected for subject of editorial comment in the *Lancet*. *The Clinic* has from time to time noted the conditions existing in American hospitals and the opinions of experts with reference to their construction and arrangement, so that the English report will be interesting in the way of comparison.

The isolation hospital has come to be so familiar a feature of sanitary administration that it is taken as a matter of necessity. It is true that the belief in its efficacy in actually stamping out disease has been modified somewhat, since it is becoming evident, even to the most sanguine, that fighting disease is a long story of continued, unremitting watchfulness. Hospitals have been found to have their own risks in the way of return cases and cross infection and sometimes, when a hospital has been permitted to become overcrowded and understaffed, it has been impossible to rate it very high as a help either to patients or to the people.

One difficulty has been to speak of such institutions as given over to the isolation of children with scarlet fever, and the low death rate—both within and outside the hospital—has suggested that there is little need of them and it has been urged further that the money spent on such institutions might be better employed in some wider

means of prevention. The advance of knowledge has wrought much change in the place of the hospital and in England isolation hospitals are rather institutions for the reception and treatment of cases of infectious disease. Less strain is laid on being able to accommodate every case during an outbreak than in having it at all times in constant use for a wider range of infectious diseases or suspicious cases. Measles and whooping cough, which were till lately seldom admitted to the hospital—save in a few institutions in Scotland—are now habitually taken in the larger hospitals. Puerperal fever and erysipelas are now frequently cared for and the treatment of tuberculosis is certain to extend in the future.

The changes in method have been followed by changes in construction. In any isolation hospital, the many-bedded ward is now indispensable. It is necessary when there are many cases of the same disease during an outbreak, while it may in some cases be safely used for more than one malady. It is, however, necessary to supplement the large wards with a number of smaller wards, cubicles or observation beds, which serve to separate individual cases without undue strain upon the staff. Open-air wards are increasing in number. With copious ventilation, "barrier" systems have been used in hospital wards with comparative safety among a number of different infections.

Doctor Parsons suggests that floor area and wall space be taken for a better standard of capacity than actual cubic contents. He suggests the relaxation of the legal 2,000 cubic feet per bed of 1,872 feet, 144 of floor and 12 running feet of wall being satisfactory. Some modifications of existing regulations are desirable in view of new and efficient materials and methods of building.

This authority finds that the forty feet required between ward buildings and between the buildings and the boundary of the hospital lot should be maintained. It is true that occasionally circumstances would make the full distance not necessary, but it is better to have a standard, since much discussion may thereby be avoided. The requirement that a smallpox hospital shall not at the same time be used for other diseases seems to Doctor Parsons reasonable and he agrees that it shall not be within a certain prescribed distance of populous neighborhoods. Temporary buildings are not countenanced from the fact that while they have a certain apparent convenience, the economic advantages are illusory. They are affected by the elements, subject to risk from fire, and the price is usually without site, fittings, water supply or furniture. It has not infrequently happened that a building listed at $2,000 has cost $5,000 to establish, fitted for its work. Last of all, this authority suggests to small places to combine for hospital purposes and thus secure one good institution instead of three or four small and inefficient ones.

"*The Clinic*," *Boston Transcript*, November 6, 1912.

The English Birthrate.

Comments on the falling birthrate in England are found in the November 2 issue of the *Journal* of the American Medical Association. It would seem that the English are facing a situation similar in kind, if not in degree, to that of France. It is interesting to note that the decline in birthrate is paralleled by a lowered marriage rate, deathrate, and rate of infant mortality. Another interesting thing which the statistics show is the relationship of the birthrate to the different religions and races represented in England. The greatest decrease is among the constituency of the Anglican Church, while the families of Roman Catholic faith maintain an almost normal level. The Irish birthrate shows an actual 3 per cent. increase. From an economic standpoint the greatest falling off is among the thrifty skilled artisans and the upper and professional classes. As to the figures themselves, the 1910 total births were the lowest since 1890, and the rate, 26.19 per 1,000, the lowest on record.

Flyless Bavaria.

News Notes in *Life and Health* for October contains the following:—

"It seems people know how to handle the fly problem in Bavaria. An enterprising American firm wrote to the United States consul in that country, offering to send samples of a new warranted-to-stick fly-paper that might be distributed in Bavaria, in the hopes of promoting sales. The startling answer was returned that there was no market for fly-paper in Bavaria, as there were no flies. The fact is the people there are so extremely clean in the matter of vacant lots, playgrounds, stables, etc., that flies would starve. It might be a good place to go for a summer vacation."

A Clearing House for Public Health.

The necessity for some organized system of correlation with regard to the various health department publications is pointed out in the following way in the Senate Memorial on the Conservation of Human Life:—

"At a recent convention of New York State sanitary officials, at which it was brought out that 'a majority of health departments throughout the country are not properly equipped,' Mr. Robert Lynn Cox, counsel for the Association of Life Insurance Presidents, said: 'Hundreds to whom I have written for copies of their reports have replied that they are not allowed sufficient money to print reports.' Mr. Cox urged that a 'clearing house of health departments' be established in order that each health department may know the methods, latest and best, used by health departments in other cities.

"Dr. Ernst J. Lederle, commissioner of health for New York City says:

" 'I would say there is certainly need of a central bureau in which certain information concerning public-health work could be obtained. If the bill now before Congress for the establishment of a National Health Department is passed, this would probably completely meet the demands. At the present time, if we desire information concerning the activities of other health departments, we are compelled to write to each one of them individually. This was illustrated in the case of the recent adoption of sections of the sanitary code of the board of health of the city of New York in relation to public drinking cups and the common roller towel and in studies on the administrative control of venereal diseases and on the occurrences and distribution of cerebro-spinal meningitis, poliomyelitis, and smallpox, in each of which instances the department was obliged to communicate directly with a number of other health departments."